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FORAGE ESTABLISHMENT, PRODUCTION, AND MANAGEMENT

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2003 Project Report

Project Title: Loon Lake Perennial Forage Variety Trial

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Project Objectives: (1) To evaluate survivability and yield of forage varieties in the grey-wooded soil zone of North West Saskatchewan.

(2) To provide a demonstration site for forage extension in the grey-wooded soil zone in cooperation with Sask Forage Council and Agriculture and Agri-Food Canada.

Project Description: In 2001, replicated forage plots were sown at the Loon Lake site. A one cut yield data was collected from the plots in 2002 and 2003. No fertilizer was applied to plots. Field days were held at the plots each July to provide producers the opportunity to learn more about pasture and forage management and production.

Project Results:

Grass Variety/Species Adaptation Test
Loon Lake, SK.
Established May 2001

Variety		2002 CUT#1 Forage Yield (kg DM/ha) July 17/2002	2003 CUT#2 Forage Yield (kg DM/ha) July 8/2003	2 Year Average Total Forage Yield (kg DM/ha)	% of Kirk
Chief	Intermediate Wheatgrass	1044	3669	2357	110
AC Knowles	Hybrid Bromegrass	863	3429	2146	100
Kirk	**Crested Wheatgrass**	**941**	**3331**	**2136**	**100**
Carlton	Smooth Bromegrass	877	3155	2016	94
Fleet	Meadow Bromegrass	724	3161	1943	91
Paddock	Meadow Bromegrass	558	3111	1834	86
Fairway	Crested Wheatgrass	796	2815	1805	85
Rosanna	Western wheatgrass	138	1897	1018	48
Boreal	Creeping Red Fescue	156	1464	810	38
Kay	Orchardgrass	381	768	575	27
Courtenay	Tall Fescue	298	751	525	25
AC Nordic	Orchardgrass	98	779	438	21
MEAN		573	2361	1467	
C.V. (%)		42	21		
LSD(0.05)		343	713		

Note: CV's are extremely high in 2002. The reviewer must exercise caution when interpreting the results.

Legume Variety/Species Adaptation Test
Loon Lake, SK.
Established May 2001

Variety		2002	2003	2 Year Average	
		CUT#1 Forage Yield (kg DM/ha) July 17/2002	CUT#2 Forage Yield (kg DM/ha) July 8/2003	Total Forage Yield (kg DM/ha)	% of Beaver
Heinrichs	Alfalfa	2180	3869	3025	120
AC Grazeland	Alfalfa	1847	3216	2532	100
Beaver	**Alfalfa**	**1573**	**3487**	**2530**	**100**
G. Million	Alfalfa	1090	3407	2248	89
AC Longview	Alfalfa	1354	3004	2179	86
Survivor	Alfalfa	1568	2732	2150	85
Spreador III	Alfalfa	1224	2884	2054	81
8925 MF	Alfalfa	1304	2731	2017	80
GALA	Alfalfa	1038	2701	1870	74
Nova	Sainfoin	917	2502	1709	68
Leo	Bird's-foot Trefoil	239	1575	907	36
Oxley	Cicer Milk-Vetch		784	784	31
Oxley II non sc	Cicer Milk-Vetch		661	661	26
Oxley II sc	Cicer Milk-Vetch	353	947	650	26
Windsor	Cicer Milk-Vetch	113	1019	566	22
MEAN		1138	2368	1725	
C.V. (%)		41	19		
LSD(0.05)		664	636		

Note: sc = scarified seed
Note: CV's are extremely high in 2002. The reviewer must exercise caution when interpreting the results.

Timothy Variety Adaptation Test
Loon Lake
Established May 2001

Variety	2002	2003	2 Year Average	
	CUT#1 Forage Yield (kg DM/ha) July 17/2002	CUT#2 Forage Yield (kg DM/ha) July 8/2003	Total Forage Yield (kg DM/ha)	% of Climax
Alma	543	1707	1125	106
Climax	**420**	**1699**	**1060**	**100**
Farol	209	1614	912	86
Promessa	312	1486	899	85
MEAN	371	1627	999	
C.V. (%)	20	13		
LSD(0.05)	143	335(NS)		

Discussion:

Precipitation in 2002 at Loon Lake was below average with 202 mm of rainfall from May 1, 2002 to August 31, 2002 resulting in reduced forage yields. Precipitation in 2002 was average with 336 mm of rainfall from May 1, 2003 to August 31, 2003 resulting in improved yields.

No fertilizer was applied to the plots to reflect management practices practiced by local producers. One forage harvest was done each year at a 10 cm height. Yields on forages such as cicer milkvetch that are prostrate in nature may be under estimated.

Conclusion:

Drought tolerance, yield potential on grey-wooded soils and longevity of grass and legume varieties was demonstrated.

Annual Forages-Suitability for NW Saskatchewan

S.M. Phelps, W. Vanin, L. Nielson, and M. Nielson

Summary

The purpose of the study was to evaluate the suitability of annual crops for forage production in NW Saskatchewan. Trials were conducted at Loon Lake, Lashburn and Scott, SK in 2003. The warm season (C4) cereals including millet, corn and sorghum were compared with the cool season (C3) cereals of barley, oats, and triticale in terms of forage yield. The crops were seeded near May 15th to simulate greenfeed production and June 10 to simulate swath grazing. Over all locations and dates, the corn out yielded all other crops. There was no significant difference between the C3 cereals and millets ($p<0.05$) in terms of dry matter yields.

Background and Objectives

Livestock production in NW Saskatchewan has been increasing. With the increase there is a need to increase forage production to meet the increasing demand for feed. Research in Canora and SE Saskatchewan indicates good yields with the warm season crops such as millet, sorghum and corn. Traditionally, cereals such as oats and barley, have made up the majority of greenfeed acres in the NW but there is more and more interest in the warm season cereals as an opportunity to increase dry matter and have quicker regrowth.

Study Description

Materials and Methods

In 2003 the Annual Forage study included sites at Scott, Loon Lake, and Lashburn Saskatchewan. Ten treatments were seeded in a randomized complete block design (RCBD) with four replicates (Table 1). SAS general linear model was used for statistical analysis. With Lashburn only one replicate could be used as seeder problems caused uneven emergence in the other 3 replicates. With Loon Lake the first replicate was removed as there results were not consistent with the other three replicates and yields were 25% of the average for the site.

The plots were seeded with a hoe drill seeding six rows with 9 inch spacing. Fertilizer was banded below the seed at a rate of 139 lbs of 36-14-0 blend at Scott, and 80 lbs of 40-25-0-5 blend at Loon Lake and Lashburn. Lashburn also had 200 lbs of 22-11-11-6 banded prior to seeding. All treatments received the same fertilizer except the corn intensive management. The corn intensive management treatment received the double rate of fertilizer. The corn intensive management was also seeded at double the rate and then every 2nd row was removed once emerged to simulate wide row spacing.

The sites were prepared for seeding by harrowing the wheat stubble then using preseed burn-off of Roundup at 0.5 l/acre. The first seed date occurred on May 16th at Scott, May 19th at Loon Lake, and May 29 th at Lashburn. The second seeding date was June 11 for both Scott and Loon Lake. Lashburn did not have a second seeding date. The second seeding date for Loon Lake is not included in the data analysis as the plots were lost prior to sampling.

Table 1. Treatments for annual forage trail 2003

Treatment	Cereal Type	Variety Use	Seeding Rate (lbs/acre)
AC Pinnacle Oats	C3	Feed Grain	114
CDC Bell Oats	C3	Forage	114
AC Ranger Barley	C3	Feed Grain	114
AC Rosser Barley	C3	Forage	114
AC Altima Triticale	C3	Spring	114
Crown Millet	C4	Forage	20
Golden German Foxtail Millet	C4	Swath grazing	20
Mega Green Sorghum	C4	Forage	20
Corn - Pioneer Hybrid 39T71	C4	Forage	15.6
Corn Intensive Management – 39T71	C4	Forage	32*

*double seeding rate then every second row was removed to simulate wide row spacings

In crop weed control was done by hand. Grasshoppers were a problem this year and Decis EC5 was used for control at all locations.

Biomass samples were to be taken at appropriate stages as outlined in Table 1. At Scott four one meter rows per plot were taken for biomass analysis on the dates specified for each crop. On these dates some of the C4 crops were not at appropriate stages but it was advised that we take samples from them prior to Aug 15 to allow time for a second biomass sample prior to first fall frost. On these dates, the crown millet was heading but the golden German millet was not. The corn was not at 50% milk line but did have immature cobs. The second biomass sampling was done 14 days after the first. For the first seeding dates at Lashburn and Loon Lake all treatments were harvested on Aug 13 and 14th, respectively, by taking 2 - ¼ metre square samples per plot. Second sampling of first seeding date and first sampling of second seeding date at Loon Lake occurred on August 18th. The samples taken were weighed (wet weight) and then dried at 55°C to obtain the dry weight. The dried samples were then ground and labeled for feed analysis. Plant heights and uniformity were recorded at biomass time.

Table 2. Stages for first biomass samples and dates samples taken at Scott.

Crop	Stage to take biomass samples	Scott – May seeding date	Scott – June seeding date
Oats	Milk dough	Aug 12	Aug 12
Barley	Soft dough	July 31	Aug 12
Triticale	Soft dough	Aug 12	Aug 12
Millet	2 weeks a/f heading	Aug 14	Aug 14
Corn	50% milk line	Aug 14	Aug 14

Results and Discussion

Data analysis was performed on combined data from one rep at Lashburn, and four reps at Loon

Lake and Scott. Results from uniformity and height are shown in table 3. The uniformity of the plots was rated on a scale of 1-10 (10 being the best). The sorghum and corn had the lowest score and were the least uniform. There was no difference in height between the warm and cool season grasses (excluding corn) but was some differences between individual varieties did exist. CDC Bell variety of oat was taller than AC Pinnacle. Crown millet was taller than golden German millet.

Table 3. Summary of Scott, Loon Lake and Lashburn.

Crop	variety	Uniformity (1-10)	Height (cm)
Oat	AC Pinnacle	8.3	66.7
Oat	CDC Bell	8.3	73.0
Barley	Rosser	8.4	61.6
Barley	Ranger	8.6	61.9
Triticale	Ultima	8.6	79.7
Millet	Crown	7.8	78.4
Millet	Golden German	8.1	63.9
Sorghum	Mega green	5.4	72.0
Corn	LL 39T71	6.4	150.3
Corn IM	LL 39T71	7.0	146.9
LSD (p<0.05)		*1.1*	*7.3*
CV		*10.7%*	*7.8%*

In terms of biomass yields, the corn produced the highest biomass yields at all locations in 2003 with an overall average of 5.5 to 6.9 tons/acre for the corn and intensively managed corn, respectively (Table 4). The sorghum produced the lowest dry matter at Scott and Loon Lake. There was no significant difference between the remaining C4 crops (millets) and the C3 cereals of oats, barley and triticale over all locations.

Table 4. Dry matter yields from all locations and all seeding dates in 2003.

		Lashburn	Loon Lake			Scott			All Location
		May	May	June	Average	May	June	Average	Average
Crop	Variety	Dry Matter Yield *(tons/acre)*							
Oat	AC Pinnacle	2.00	3.00	2.24	*2.62*	2.66	3.17	*2.91*	*2.72*
Oat	CDC Bell	1.29	2.69	1.88	*2.29*	2.49	2.99	*2.74*	*2.44*
Barley	Rosser	1.54	2.63	2.27	*2.45*	2.14	2.17	*2.16*	*2.26*
Barley	Ranger	2.00	2.38	2.29	*2.34*	2.66	2.94	*2.80*	*2.53*
Triticale	Ultima	1.80	2.51	2.60	*2.55*	2.47	2.75	*2.61*	*2.54*
Millet	Crown	2.46	2.01	2.52	*2.27*	3.15	2.83	*2.99*	*2.62*
Millet	Golden German	2.63	1.86	2.11	*1.99*	2.68	2.38	*2.53*	*2.28*
Sorghum	Mega green	1.94	0.95	1.27	*1.11*	1.38	0.84	*1.11*	*1.16*
Corn	LL 39T71	5.59	6.04	5.96	*6.00*	4.35	5.67	*5.01*	*5.51*
Corn IM	LL 39T71	9.35	5.52	9.05	*7.28*	4.96	7.44	*6.20*	*6.90*
LSD (p<0.05)									
CV									

At Loon Lake the earlier seeding date shows oats out yielding barley. With the second seeding date the CDC Bell oats has lower dry matter than the other variety of oats and the barley varieties. This is due to the CDC Bell being less mature and was in a more vegetative state at the time of sampling. As all treatments were harvested on the same date varieties and crops may not have been at the most appropriate stage for forage harvest. Over all locations and seeding dates AC Pinnacle (oat) produced the highest dry matter yield over all other C3 crops and varieties tested and this is consistent within locations and seeding dates.

The crown millet out yielded the German golden millet overall, and at all locations, with the exception of Lashburn. During the heat in August the golden German millet started to senesce while the crown millet remained green. The crown millet headed much earlier than the golden German millet at all locations.

The sorghum had poor emergence and not very uniform stands. Samples were taken where plants were and therefore may overestimate the dry matter yields for these crops. There were large areas within the plots where no crop was present.

With the corn, emergence was slow but fairly even stands did emerge. The intensively managed corn did out yield the solid seeded corn in terms of dry matter production over all locations and seeding dates. Corn was the highest producer of forage in 2003 as a result of the extra heat units as it shows up in growing degree days (GDD) in Figure 1. In a normal year we average approximately 1000 GDD at Scott during the months of June, July and August which is the time during which most crop growth occurs. For 2003 the GDD for that same period was 1150 with the additional GDD being gained during the month of August. As corn is a crop that requires higher heat units and longer GDD than the other forages tested, it is not surprising that the corn outperformed the other forages in 2003.

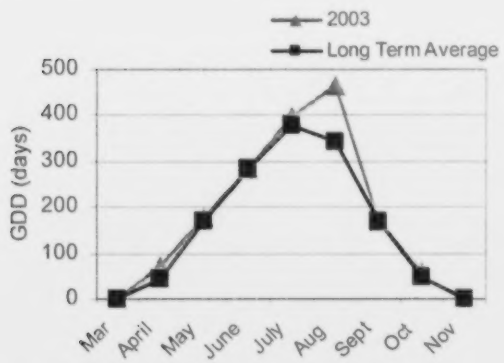

Figure 1. Growing degree days (GDD) at Scott in 2003 compared to long term average.

Grasshoppers were an issue in 2003. Control was implemented but as the grasshoppers reached later stages the options were not as effective and the grasshoppers moved in from adjacent areas quite readily.

Conclusions

Based on results obtained from three locations in 2003 it is apparent that under the growing conditions in 2003 the corn outperformed all other forages in terms of biomass production. Between the remaining treatments there was no significant difference between oat, barley,

triticale and millet. Sorghum was the lowest yielding and the most variable forage cereal in 2003.

Indications for further development

It is apparent that the relative performance of annual forage species is highly influenced by environmental conditions. Continued analysis of these forages over a number of years and a number of conditions is warranted to truly evaluate their suitability for forage in NW Saskatchewan.

Yield and Quality of Annual Crops for Swath Grazing and Greenfeed when Seeded on Three Dates in Northeast Saskatchewan

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Background

There are a number of crop options to consider when seeding a crop for green feed, silage or swath grazing. The most reliable have been oats and barley. Interest in triticale for silage has grown over the past few years. Recent research at the Brandon Research Station has indicted that some millets may be well adapted to use as swath grazing crops. Millets are warm season crops. That means they need warmer temperatures to mature than our cool season crops like oats and barley. Past experience with millets and other warm season crops have shown when they are seeded in the spring and harvested in early August when our cool season crops are in the soft dough stage, the warm season crops tend to produce less dry matter.

This comparison may have been slightly unfair to some warm season crops since they tend to grow best in July and August if precipitation is available. Since some warm season crops like Golden German millet are late maturing they may be better suited to late season use as swath grazing than our cool season crops.

Method

One variety of Oats, barley, triticale and Foxtail millet were each sown on May 24, June 15 and July 3, 2002 and May15, June 16, and July 3, 2003 in seven inch row spacings, at the Melfort Research Farm in east central Saskatchewan. Plots were arranged in a randomized complete block design with four replications seeded on wheat stubble. Plot size measured 2 metres by 10 metres.

The soil type was a Melfort silty clay loam. All plots were fertilized with 145 lb/ac of 34.5-0-0 broadcast prior to seeding. Yield was determined by clipping the centre 1.5 metres of each plot at the appropriate harvest date to 5 cm using a sickle type forage harvester. Samples were weighed and subsamples of each plot were oven dried in a forced air oven at 50 ^{o}C and analysed for moisture, PC, TDN, and ADF.

The varieties of annual forage crops used in this experiment were AC Ultima spring triticale, Foothill oats, Ranger barley and Golden German foxtail millet. Crops were cut at the soft dough stage for the cereals and the early heading stage for the Golden German foxtail Millet. Seeding rates were 3 bu/ac, 2 bu/ac, 2 bu/ac and 20 lb/ac for the Oats, Barley, Triticale and millet, respectively. The harvest dates for 2002 and 2003 for each crop are provided in tables 2 and 3.

Each crop was sampled for quality and yield at swathing and was sampled again for quality on December 1.

The monthly rainfall and average temperature for 2002 and 2003 were collected at the Melfort research farm. Long term averages are for the Melfort research farm. The precipitation and temperature data is provided in table 1.

Table 1: Temperature and precipitation for 2002 and 2003 and the long term average for Melfort, Saskatchewan.

Month	Ave. Daily Temperature			Total Monthly Precipitation		
	2002	2003	LT Ave.*	2002	2003	LT Ave.
	°C			mm		
January	-	-	-	9.3	4.7	17.7
February	-	-	-	10.0	10.0	13.9
March	-	-	-	14.6	10.7	18.5
April	-2.5	3.4	2.2	17.3	28.7	20.7
May	6.8	12.1	10.6	5.0	45.0	41.4
June	17.1	15.9	15.5	56.2	64.0	61.9
July	19.8	18.1	17.6	57.8	35.8	66.7
August	16.0	19.9	16.3	130.6	24.4	53.1
September	11.0	11.1	10.4	24.6	23.2	41.4
October	- 2.2	5.9	4.0	25.4	0	26.6
November	-	-	-	4.1	**	
December	-	-	-	27.4	**	

* Melfort average 1971-2000.

** Data not available due to equipment failure.

Results

The cool season crops did not fair well through the dry conditions of the spring and summer in 2002. They grew little and matured to the soft dough stage in late July. At this point they were cut. Yields were very low. Millet although it did not grow well through the drought, remained leafy and was able to respond quickly once we received a few rains in July and August. Oats barley and triticale did produce re-growth, which was cut in late September. Oats produced the most re-growth followed by barley then triticale. In 2002 millet was the highest yielding of the four crops tested, even when the re-growth of the early cut oat, barley and triticale was included in the yield.

Table 2 provides a complete summary of the one cut yield and quality of the four annual crops used in this project for each of the three seeding dates in 2002. In this project Millet produced the highest one-cut yield. This was to a large part due to the fact that, because it did not mature, it was left standing longer than the cereal crops.

The cereals cut May 24 re-grew enough for a second cut in September. The regrowth yields are not included in the table below. The re-growth yields for Barley, Oats and Triticale were 3112, 4459, 2829 kg/ha respectively. There was no regrowth in 2003.

Table 2: Yield and quality of oats, barley, triticale and Golden German millet and harvest date for these crops for three seeding dates in 2002 at Melfort.

Crop	Seeding date	Harvest Date	Yield (Kg/ha)	% Protein	% TDN
Barley	July 3	September 11	6290	14.3	60
Barley	June 22	August 21	4540	14.9	64
Barley	May 24	July 19	2435	15.1	64
G. G. Millet	July 3	September 23	4200	14.7	62
G. G. Millet	June 22	September 16	6765	13.9	60
G. G. Millet	May 24	September 4	7455	12.5	56
Oats	July 3	September 23	5150	14.0	57
Oats	June 22	August 28	6125	12.4	55
Oats	May 24	July 19	2145	14.7	61
Triticale	July 3	September 16	5300	11.5	60
Triticale	June 22	August 28	3930	10.1	62
Triticale	May 24	July 19	2685	11.8	62

Table 3: Yield and quality of oats, barley, triticale and Golden German millet and harvest date for these crops for three seeding dates in 2003 at Melfort.

Crop	Seeding date	Harvest Date	Yield (Kg/ha)	% Protein	% ADF
Barley	May 15	July 21	6490	9.7	28.3
Barley	June 15	August 18	5550	8.1	27.8
Barley	July 3	September 4	2670	12.0	22.7
G. G. Millet	May 15	August 18	8540	8.1	31.1
G. G. Millet	June 15	September 4	5220	8.9	29.9
G. G. Millet	July 3	September 4	4320	10.4	28.9
Oats	May 15	July 21	7315	9.0	33.2
Oats	June 15	August 18	5315	9.7	34.5
Oats	July 3	September 4	3960	9.9	31.0
Triticale	May 15	August 11	8555	6.3	35.4
Triticale	June 15	August 18	4990	9.6	30.0
Triticale	July 3	September 4	3135	10.8	25.2

The 2003 growing season was substantially different than 2002. Spring moisture was adequate for good establishment. Very dry conditions after late June resulted in very poor growth in July and August. The above average temperatures in July and August stressed crop growth and reduced potential yields.

Table 3 provides a complete summary of the one cut yield and quality of the four annual crops used in this project for each of the three seeding dates in 2003.

The highest yielding crops in 2003 was triticale seeded May 15 and harvested August 11 and Golden German millet seeded May 15 and harvested August 18. Yield from the June 15 and July 3 seeding dates for all crops were substantially lower reflecting the dry hot conditions in July and August.

Protein content of all crops was higher for the July 3 seeded treatment than the May 15 seeding. ADF was measured and reported in 2003. ADF declined from the early to late seeding treatment for all crops.

In this project Golden German foxtail millet seeded in late May produced good yields in both 2002 and 2003. The concern with this early seeding date is weed control. Golden German millet does not compete well with weeds in the early part of the growing. Seeding into a clean seedbed is important if seeding this early.

SFC-0267-D

Cover Crop Seeding Rate Trial

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Background

In northeast Saskatchewan the majority of forage crops are still seeded with a cover crop. Quite often this is done to provide some return in the year of forage establishment. But it is also done to protect fragile soils from wind erosion and also to help prevent chaffy forage seed from bridging in the seed box or tank. The main concern with cover crops has always been the competition they provide to the establishing forage plants. When a cover crop is used it is recommended to seed it at less than ½ the normal seeding rate. However some producers feel that greenfeed production would suffer if the seeding rate is drastically reduced. As a result they tend to seed the cover crop heavier than recommended in order to ensure an adequate greenfeed crop for harvesting.

The purpose of this project was to determine how various seeding rates of a cover crop of oats and barley effect the yield of the cover crop for greenfeed and the yield and establishment of the under seeded meadow brome and alfalfa crop.

Method

This trial was seeded at Nipawin in 2000 and 2001 and Melfort in 2002 and 2003. The cover crops were cut in the year seeded. The under seeded alfalfa brome plots were cut the year following seeding.

The trial consists of a low, medium and high cover seeding rate treatment for each of a barley and oat cover crop along with a no cover crop treatment. Three seeding rates of Rosser barley (27.5 lb./ac, 55 lb./ac. and 110 lb/ac.) and CDC Baler oats (17 lb./ac., 34 lb/ac. and 100 lb/ac.) and the no cover crop treatment were seeded in a randomized completed block design with four replications. Seeding occurred in late May of each year.

The entire trial was under seeded, perpendicular to the cover crop seeding, with a mixture of 8 lb./ac. meadow brome grass and 1 lb./ac. alfalfa. All cover crop plots were 4 ft. wide x 20 ft long. Row spacing for the cover crop and under seeded forage mixture was 12 inches at Nipawin and 6 inches at Melfort.

The cover crops were harvested with a plot harvester to a height of 2 inches in either late July or early August. At harvest the barley was in the soft dough stage and the oat in the late milk stage.

Treatment	**Green Feed Yield (kg/ha)**			
	2000	**2001**	**2002**	**2003**
No Cover	2216	1651	1155	325
Oat 17 lb./ac	7122	5819	4618	6483
Oat 34 lb/ac	7888	7016	4682	6925
Oat 100 lb/ac	9326	9533	5700	8759
Barley 27.5 lb/ac	8431	7975	4295	8272

The alfalfa bromegrass plots were harvested the year after seeding. At Nipawin these plots were harvested in late July or early August of 2001 and 2002 for the 2000 and 2001 seedings. At Melfort the alfalfa bromegrass plots were harvested in early July of 2003 for the 2002 seeding.

Results

Yield results for the cover crops are provided in Table 1.

Table 1: Greenfeed yields.

Barley 55 lb/ac	8942	7859	4115	9900
Barley 110 lb/ac	9092	8458	3901	10216
CV	13	17	11	13
LSD (0.5)	1508	2129	646	1374

It is important to note that the 2001 cover crop data only includes 3 replicates, which had high variability. The variability was probably due to dry conditions and location of the plot at the Nipawin site.

The no cover crop treatment yielded significantly less forage in the year of seeding than the cover crop treatments. The very low yield of the no cover crop treatment in 2003 was probably a result of a heavy grasshopper infestation.

There was no significant difference in oat greenfeed yield when seeded at 17 or 34 lb/ac in any of the 4 years of this project. Oats seeded at 100 lb/ac produced higher yields than oats seeded at either17 and 34 lb/ac in all 4 years.

There was no significant difference in barley greenfeed yield at any of the three seeding rates in 2000, 2001, and 2002. In 2003 barley seeded at 55 and 110 lb/ac yielded significantly more greenfeed than barley seeded at 27.5 lb/ac. Barley yields were not significantly different between the 55 lb/ac and the 110 lb/ac seeding rates in 2003.

The data indicates that cover crop seeding rate had no effect on the yield of the forage crop the year after seeding for 2000 and 2001 (table 2). The use of a cover crop did reduce brome and alfalfa yield for the 2002 seeding, however the type of cover crop or the seeding rate did not appear to affect yields in any of the three years of this project.

Table 2: Alfalfa/bromegrass yields.

Treatment	**Alfalfa/ Brome Yield (kg/ha)**			
	2000 Seeding		**2001 Seeding**	**2002 Seeding**
	2001	**2002**	**2002**	**2003**
No Cover	4170	1399	811	4618
Oat 17 lb./ac	4640	1497	1176	2621
Oat 34 lb/ac	4850	1639	952	2513
Oat 100 lb/ac	4240	1256	925	2291
Barley 27.5 lb/ac	4720	1080	704	2067
Barley 55 lb/ac	4630	974	811	2055
Barley 110 lb/ac	3780	1519	1517	2032
CV	26	24	19	19

LSD (0.5)	ns	480	339	738

The quality of the no cover crop treatment was consistently better than the cover crop treatments. There was no consistent trend in the quality of the cover crop treatments, indicating seeding rate or crop had little effect on quality (table 3).

Table 3: Greenfeed and alfalfa/bromegrass protein and ADF levels in the year of seeding.

Treatment	**Green Feed Quality**							
	2000		**2001**		**2002**		**2003**	
	% P	*% ADF*	*% P*	% ADF	% P	% ADF	% P	% ADF
No Cover	21	36	19	28	24	30	16.5	27.3
Oat 17 lb./ac	11	39	12	32	14	36	9.2	26.1
Oat 34 lb/ac	11	38	13	32	14	37	9.7	26.7
Oat 100 lb/ac	12	38	12	34	14	41	8.8	26.5
Barley 27.5 lb/ac	12	34	12	28	16	33	7.6	32.5
Barley 55 lb/ac	11	34	11	34	14	34	7.0	33.4
Barley 110 lb/ac	10	35	11	30	15	31	6.2	34.6

Discussion

In the four years of this trial oat appeared to be more sensitive to seeding rate than barley. For the three seeding rates used in this project barley greenfeed yield varied from 8- 19% between the low and high seeding rate and in only one year was this variation significant. For oats, greenfeed yield varied from 19-39% between the low and high seeding rate. In all four years the high seeding rate yielded significantly more greenfeed than the low and medium seeding rate.

In this study seeding 0.5 bushels of barley for greenfeed was adequate to maximize greenfeed yield in three of four years. Oats, on the other hand, produced the best greenfeed yields in all four years when seeded at 3 bushels per acre. There was no significant difference between oats seeded at the medium and low rate.

In this study seeding rate of the cover crop did not significantly affect the second year (first production year) forage yield of the meadow brome alfalfa mixture in two of three years.

In this project meadow brome and alfalfa was cut in late July or early August of 2001 and 2002 when the greenfeed was cut. In both these years there was no significant effect of the cover crop on hay yield. In 2003, the meadow brome alfalfa was cut in early July. In that year there was a significant reduction in forage yield as a result of the preceding cover crop. The reduction experience in this year probably reflects the competition experienced by the under seeded forage. However it may also reflect the difference in harvest date. The early harvest in 2003 may have resulted in the under seeded forage not having sufficient time to compensate for the cover crop completion experienced the previous year.

Yield and Quality of Yellowfeed and Greenfeed Oats and Barley Harvested at Melfort

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Background

Currently annual cereal crops to be baled are cut, crimped, and windrowed in the soft dough stage. The windrow lies in the field until the material is dry for baling. During this interval, rain may occur which lengthens the drying process. Also, the windrow is difficult to dry and may require turning before it can be baled.

A new technique is to spray the crop in the soft dough stage with glyphosate. The crop is allowed to stand until it is dry, then cut and baled. This method decreases harvest risk and allows the producer to schedule harvest, similar to chopping silage.
Added benefits are excellent perennial weed control and reduced cutting cost because the feed can be cut with a swather instead of a mower conditioner. If the crop can be dried standing with minimal losses, this method would be an alternative to silage with significant cost savings to producers.

The objective of this project was to determine the effect glyphosate had on the yield and quality of oat and barley greenfeed.

Method

Replicated plots of each of oat and barley were seeded at the Melfort Research Farm in 2001. Half of each plot was sprayed with 1 litre of glyphosate when the barley reached the soft dough stage and the oats reached the milk stage of development on July? . Both the sprayed and unsprayed crops were swathed and baled. The unsprayed crops were swathed July 27 and baled Aug 8. The sprayed crops were swathed and baled Aug 10. The bales were weighed to determine the total harvested forage from each of the sprayed and unsprayed treatments for each crop. Feed samples from the baled crop were taken immediately after baling and sent for protein and energy analysis.

In 2002 replicated plots of oat and barley were seeded on May 24. Half of each plot was sprayed with Roundup at 1 litre per acre shortly (8 days) before the soft dough stage of

the barley. Spraying occur earlier than the soft dough stage because it was observed in 2001 that the crop took 4-5 days of good warm weather to start to dry down. During this time it will continue to mature. The other half of the plot was swathed at the late milk stage of the barley. The unsprayed barley and oat crops were swathed on the same date. Yield and quality at swathing was measured for both treatments. Because the green feed lied in the swath for a number of days while drying the quality of the green feed was measured again at baling. The crop was sprayed on July 13, 2002. The unsprayed plots were baled on July 30, 2002.

In 2003. replicated plots of each of oat and barley were seeded at the Melfort Research Farm. Half of each plot was sprayed with 1 litre of glyphosate when the barley reached the soft dough stage and the oats reached the milk stage of development on late July. The unsprayed crops were swathed late July and baled early August. The sprayed crops were swathed and baled Aug 10. The plots were sampled to determine dry matter yield at the time of swathing. Feed samples from the baled crop were taken immediately after swathing and sent for protein and energy analysis.

Results

Yield results are given in Table 1 and 2.

Table 1: Yield (D.M.), % protein and % total digestible nutrients (TDN) of barley and oat green and yellowfeed harvested at Melfort in 2001.

Crop	***Treatment***	***Dry Matter (kg/ha)***	***% Protein***	***% TDN***
Oat	***Unsprayed***	***2860a***	***15***	***61.3***
Oat	***Sprayed***	***2690a***	***10.5***	***61.7***
Barley	***Unsprayed***	***3558a***	***16.9***	***61.8***
Barley	***Sprayed***	***2744a***	***13.2***	***63.2***

Table 2: Yield (D.M.), %protein and % total Digestible nutrients (TDN) of barley and oat green and yellowfeed harvested at Melfort in 2002.

Crop	Treatment	Dry Matter (kg /ha)	% Protein	% ADF
Oat	Unsprayed	3925a	12.6	31.3
Oat	Sprayed	2941b	10.7	33.2

Barley	Unsprayed	3489a	12.4	24.8
Barley	Sprayed	2825a	13.4	27.7

Table 3: Yield (D.M.), %protein and % total Digestible nutrients (TDN) of barley and oat green and yellowfeed harvested at Melfort in 2003.

Crop	Treatment	Dry Matter (kg /ha)	% Protein	% ADF
Oat	Unsprayed	9540a	9.2	30.5
Oat	Sprayed	8343b	8.2	31.1
Barley	Unsprayed	9562a	8.9	29.4
Barley	Sprayed	9124a	6.9	32.4

In 2001 the yields of oat green feed and yellow feed were not significantly different. There was a reduction in the barley yield for the sprayed treatment however this difference was not determined to be statistically significant because of the variability within the plots. This variability was caused by uneven germination due to dry conditions and Roundup drift from an adjacent project that affected this project reducing the number of usable replicated plots. Unfortunately the results from this project must be used with caution. In 2001 in this demonstration at Melfort spraying Roundup on green feed did not affect the yield for either the oats or the barley. This is consistent with similar results obtained in greenfeed and yellowfeed projects in Southeast Saskatchewan in 2001.

In this demonstration we collected only one sample from each of the treatments for feed quality analysis. The total digestible energy content of both crops was not affected by the application of glyphosate.

This may not have been the case for protein levels. The yellowfeed oat treatment was 4.5 percentage points lower in protein than the greenfeed treatment and the barley yellow feed was 3.7 percentage points lower in protein than the barley greenfeed. This is unusual because results from an on-farm sample in 2001 showed that the protein content was not significantly affected by the use of preharvest glyphosate on greenfeed.

With only one sample taken this difference in protein content was probably a result of sampling error.

In 2002 there was significant difference in yield but not quality between the sprayed and unsprayed crop. In this trial, spraying glyphosate, to aid in dry down, did result in loss of oat greenfeed production. This was probably a result of spray date. By spraying the crops 1 week earlier than the unsprayed crops were harvested some yield was lost. Also because oats is slightly later maturing than barley it would have been at an earlier stage of development and this would have reduced its yield even more. Another factor that may have contributed to the yield difference was soil moisture. Very dry conditions in June and early July resulted in very low yields and earlier than normal maturity. Five days after spraying the site received 1 inch of precipitation over a three day period. The

unsprayed crops would have been able to respond to this moisture. Oats would have been able to respond best to this precipitation because it was less mature than the Barley.

Protein was only slightly lower for oats and slightly higher for barley treated with glyphosate versus the untreated oats. ADF was only slightly higher in the sprayed than the unsprayed treatments for both crops.

In 2003 the yield of oats was reduced due to the glyphosate application. This was probably again a result of spraying the oat crop at the milk stage. At this stage oats will still have an opportunity to fill and increase dry matter yield. Barley yield was not significantly affected by glyphosate application in 2003.

The sprayed oats and barley treatments tended to be slightly lower in protein and similar in ADF in 2003.

Over the three years, protein levels tended to be slightly lower in the sprayed treatments for both crops, however this was not consistent or significant in all years. Yields were slightly lower for sprayed oats than unsprayed oats, again however, this was neither consistent or significant in all years. Barley yield was not significantly affected by glyphosate application in any of the three years.

In all three years this project was completed in July or August when drying conditions were relatively good. Producer experiences with glyphosate applications in late September and early October of 2002 often did not result in adequate dry down of the crop. This was probably a result of the higher humidity experienced that fall, resulting in only a few good drying days.

More trials need to be undertaken to better determine the effect of spray date on yield and quality of greenfeed crops.

Pasture Production of Annuals

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Background

Yield is a major consideration in choosing an annual forage crop. Most of the yield data on annual crops comes from silage or greenfeed trials where the crop is cut only once in the summer when the crop reaches the soft dough stage. In most trials using this cutting strategy oats and barley out yields the winter cereals and annual ryegrass. The strategy of only using peak yields works well for silage and green feed comparisons however for pasture production crops are generally grazed before they reach their peak production in order to maintain quality for an extended period. The crop is also often grazed in a rotation 2-3 times. This use of spring crops prior to the soft dough stage reduces overall production. The multiple cutting or grazing of a pasture system can favour plants that can quickly re-grow from intact leaves, such as winter cereals and annual ryegrass.

The objective of this project was to determine the yield and quality of various annual crops under simulated grazing conditions.

Method

Nine annual crops were seeded in a randomized complete block design with four replicates at the Melfort Research Farm in the spring of 2002 and 2003. The crops included were winter wheat, fall rye, winter triticale, oat (Foothills), annual rye grass (Westerwolds and Italian), spring triticale, barley (AC Ranger), Golden German millet. All crops were cut 3 times during the growing season in 2002 and twice during the growing season in 2003 to determine growth under simulated grazing. Cutting dates were July 19, Aug. 19 and September 20 in 2002 and July 9, and July 31 in 2003. Growing conditions in 2003 did not support a September cut. Yield was determined at each cutting date.

Results

The annual precipitation and average daily temperatures for the two years are provided in Table 1

Month	Ave. Daily Temperature			Total Monthly Precipitation		
	2002	2003	LT Ave.	2002	2003	LT Ave.
	°C			mm		
January	-	-	-	9.3	4.7	17.7
February	-	-	-	10.0	10.0	13.9
March	-	-	-	14.6	10.7	18.5
April	-2.5	3.4	2.2	17.3	28.7	20.7
May	6.8	12.1	10.6	5.0	45.0	41.4
June	17.1	15.9	15.5	56.2	64.0	61.9
July	19.8	18.1	17.6	57.8	35.8	66.7
August	16.0	19.9	16.3	130.6	24.4	53.1
September	11.0	11.1	10.4	24.6	23.2	41.4
October	- 2.2	5.9	4.0	25.4	*	26.6
November	-	-	-	4.1	-	-
December	-	-	-	27.4	-	-

1. Melfort average 1971-2000

* Precipitation not available due to equipment failure.

The yield results for each of clipping date and total yield for 2002 and 2003 are provided in tables 2 and 3 below.

Table 2: Yield (kg D.M./ha) of nine annual forage crops cut three times during the growing season at Melfort in 2002.

Crop	Cut 1 July 19	Cut 2 Aug. 19	Cut 3 Sept 20	Total Yield 2002
Italian Ryegrass	464d	2640a	2334a	**5439a**
Annual ryegrass	953cd	2085b	2252a	**5290a**
Oats	1874b	984d	1227d	**4085b**
Winter Wheat	336d	1815bc	1698bc	**3850b**
Winter Triticale	501cd	1491c	1797b	**3789b**
Spring Triticale	2694a	781d	276e	**3752b**
Fall Rye	530cd	1663bc	1296cd	**3489bc**
Golden German Millet	1223bc	2009b	251e	**3485bc**
Barley	1700b	270e	620e	**2591c**

Means with the same letter within a column are not significantly different.

Table 3: Yield (kg D.M./ha) of nine annual forage crops cut two times during the growing season at Melfort in 2003.

Crop	Cut 1 July 9	Cut 2 July 31	Total Yield 2003
Oats	3562a	1656ab	**5217a**
Spring Triticale	3588a	1107cd	**4694a**
Barley	3642a	824d	**4467a**
Annual ryegrass	1255b	2131a	**3386b**
Golden German Millet	1237b	1856ab	**3092bc**
Italian Ryegrass	746b	1569bc	**2315cd**
Winter Triticale	1283b	701d	**1984d**
Fall Rye	1206b	728d	**1934d**
Winter Wheat	1025b	822d	**1847d**

Means with the same letter within a column are not significantly different.

Discussion

Precipitation had a significant affect on the pasture yields of the various crops used in this trial. Below normal precipitation, especially in May and June, limited production of all crops in 2002. The annual and Italian ryegrasses had the highest total yield with the vast majority of their growth coming after July 20. Oats yielded relatively well compared to the other spring cereals, barley and triticale. This was mainly due to the greater growth experienced from August 19 to the late September cut. The three winter cereals produced similar amounts of dry matter with most of this production coming in the second and third cut. Golden German millet yielded well in the first and second cuts but produced very little growth after the August 19 cut.

The highest yielding crops in 2003 were oats, spring triticale and barley. The lowest yielding crops were the winter crops winter wheat, fall rye and winter wheat. This difference from 2002 can be explained by the precipitation pattern in 2003. More snow in 2002-2003 plus substantially more precipitation in May got all crops off to a good start which favoured the spring cereals. The dry July and August and a warmer August in 2003 reduced the potential yield of the crops that could have responded to good moisture conditions in the summer, like the winter cereals, Italian ryegrass and Golden German millet. In 2002 the winter cereals and Italian ryegrass responded to August moisture, producing substantial yield between August 19 and September 20. In 2003 the dry hot conditions resulted in no measurable growth during this period.

In this project we saw spring cereals yield well when precipitation came in the first half of the growing season. When precipitation came in the last half of the growing season, spring-seeded winter cereals and Italian ryegrass yielded well.

In Northeast Saskatchewan, oats remains a good choice for annual pasture because of its ability to out yield spring-seeded winter cereals early in the growing season and regrow better than other spring cereals when precipitation comes later in the growing season.

Species adaptation for annual forage in West Central Saskatchewan (Netherhill)
SFC-0267-G

Patty Robertshaw and Dale Weisbrot SAFRR Randy Pastl (summer field staff Brain Bann & Michel Gavil)
SFC Land Owner Co-operator - Don Fuhrman

Ten annual forage treatments were included in a four replicate randomized block plot design to demonstrate annual forage species adaptation for the brown soil zone of west central Saskatchewan. This demonstration is supplemental to the more detailed *Species Adaptation for annual forage production and swath grazing potential* study which had plots located at Agri-ARM sites at Swift Current, Redvers, Canora, Indian Head, Melfort, Scott and Loon Lake. The objective of the provincial study (reported separately) was to evaluate forage species for adaptation, quality and yield production in annual forage and swath grazing systems. Six core varieties were included at all locations.

The following ten variety treatments were sown into summerfallow on May 23, 2003 (treatments indicated as "core" were included in all the sites :

Barley – Ranger (core)
Oat – AC Pinnacle (core)
Sorgum-sudan grass – Mega green (core)
Millet – Crown (core)
Millet – Golden German foxtail (core)
Corn – Pioneer Hybrid 39T71 (core)
Corn – HLS007 Prairie seeds
Turnip – Marko (conventional)
Turnip – Tyfon (hybrid)
Canola – LL 2663 hybrid

1. **AC Ranger Barley:** High yielding for feed grain and green feed production. Good disease resistance and lodging resistance.

2. **AC Pinnacle Oats:** High yielding, late maturing, very good disease resistance with good lodging resistance.

3. **Mega Green Sorghum X Sudangrass Hybrid:** Very tall, leafy, warm season annual forage crop best suited for silage or swath grazing. Good drought and cold tolerance. Good feed value (13to 14.5% CP and 57 to 60% TDN). High yielding, requiring good weed control, high fertility and rainfall for production. Very late maturing with no heading. Prussic Acid and Nitrate accumulation occurs with crop stress. 2002 yield in Manitoba Corn Trials was 4.65 ton DM/acre with 10% CP and 57% TDN.

4. **Crown Millet:** Early maturing, warm season crop. A forage variety of proso millet. Moderate yield with high palatability and feed value (16% CP and 58% TDN). Low seed cost, establishes quickly, requires moderate fertility and average rainfall. Heading occurs 50 to 55 days after crop emerges.

5. **Golden German Foxtail Millet:** Tall, leafy, warm season crop with late maturing. Heading occurs 75 to 80 days after crop emergence. Well suited to swath grazing; good drought tolerance. Efficient water user. High forage yield with good palatability and feed value (12 to 14% CP and 55 to 57% TDN). A moderate nitrogen fertilizer rate is adequate for good production.

6. **Corn:** Very tall, high yielding, warm season annual forage crop. Late maturing, with medium feed value. Requires optimum plant density, weed, control, fertility and rainfall for economical production. Requires higher heat units than other warm season crops. Yields very from year-to-year. (Wally Vanin SAFRR)
   - 6.1. **Pioneer Hybrid 39T71:** Comparative Relative Humidity: 77. Liberty Link gene for resistance to Liberty herbicide. Above average early growth and moderate stalk strength. 2250 heat units. GDU'S to Silk 970. GDU's to physiological maturity 1810.
   - 6.2. **Hyland Seeds 007:** Heat Units 2225, suitable for silage or grazing. Early corn variety with more grain content in silage. Less lignin, thinner rind and higher levels of sugars throughout the plant than grain varieties. Feed value of 8% CP and 67% TDN.

7. **Turnips:** Turnips are a high quality, high yielding crop, highly digestible, ideally used to supplement or extend the grazing season. Adapted to the short, cool growing season of the Prairies, in fact the tops will tolerate -5 to – 10 C, while the bulbs will tolerate -10 C to -15 C. Maintain their quality at maturity. Can contain glucosinolates; and if fed to excess, may affect the grazing animals' thyroid or cause problems like anemia. Turnips can be grazed in two ways. Either, graze turnips once in the fall when the entire plant top and bulb can be utilized. Or, graze the tops early when there is 24" to 20" of top growth, (about 90 days after seeding). Leave the bulbs intact so that the plants regrow and then both the top and bulb can be grazed a second time, later in the fall. (Prairie Seeds)
   - 7.1. **Marko:** Conventional turnip with significant leaf and bulb growth. More carbohydrates.
   - 7.2. **Tyfon:** Hybrid between turnip and Chinese cabbage primarily top growth – little or no bulb.

8. **LL2663 hybrid Canola:** Liberty herbicide tolerant Argentine canola. In crop production area 2 tested 123 % of AC Excel yield with an average maturity at 95 days and very good resistance to lodging. Producers should be diluting the canola with other feeds to try to keep the total intake of canola at 60% of the ration or less. Note 2002 feed tests of canola have shown high levels of Sulphur. NRC recommends that mature cows should not exceed 0.4% sulphur (total diet concentration on a 100% DM basis). Levels of dietary sulphur in excess of 0.4% can do a number of things: There can be a reduction in feed intake and lower growth rates; High levels of dietary sulphur can form sulphates which in turn causes copper deficiency; Scouring or; Thiamin deficiency which in turn can lead to Polioencephalomalacia. (Brian Doig SAFRR)

The extension value from this demonstration (along with other plots) at the Netherhill site was evident in a July 22, 2003 field day and tour. The Forage Tour effort was jointly resourced among staff from Saskatchewan Watershed Authority, Saskatchewan Forage Council, AAFC-PFRA and SAFRR in the Fiske - Netherhill area. Producers viewed the forage plots at Netherhill, manure as well as liquid fertilizer applications on crested wheatgrass, and a grazing system near Fiske. No data could be generated from the two turnip and canola treatments due to extreme flea-beetle infestation.

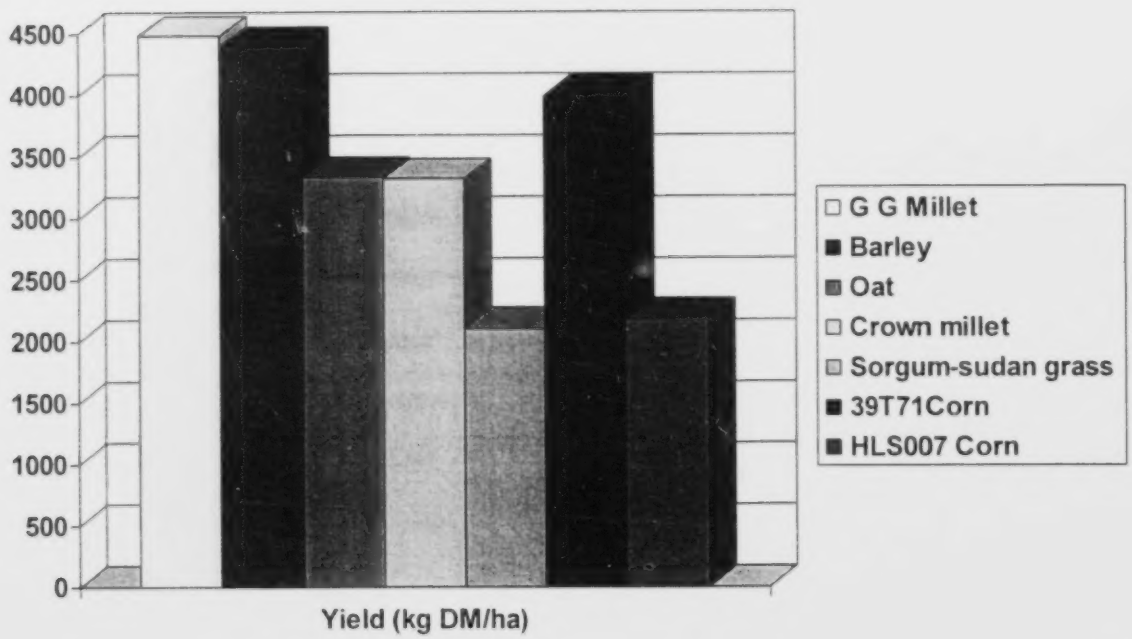
2003 SAFRR C3/C4 Annual Variety Trials
SFC-0267-G Netherhill, Sask.
Sown May 23, 2003

Variety	2003			
	Forage Yield (kg DM/ha) Aug. 12/2003	Corn Forage Yield (kg DM/ha) Sept 19/2003	Total Forage Yield (kg DM/ha)	% of Ranger
Golden German Millet – foxtail		4477	4477	102
Barley – Ranger	**4391**		**4391**	**100**
Oat - AC Pinnacle	3329		3329	76
Crown millet		3317	3317	76
Mega green Sorgum-sudan grass		2105	2105	48
MEAN	3524		3524	
C.V. (%)	20		20	
LSD(0.05)	1107		1107	

Variety	2003			
	Corn Forage Yield (kg DM/ha) Sept 19/2003	-	Total Forage Yield (kg DM/ha)	% of Pioneer 39T71
39T71 (Pioneer Hybrid)	**3982**	**-**	**3982**	**100**
HLS007 (Prairie seeds)	2179	-	2179	55
MEAN	3080	-	3080	
C.V. (%)	17	-	17	
LSD(0.05)	1578	-	1578	

2003 SAFRR C3/C4 Annual Variety Trials
SFC-0267-G Netherhill, Sask.
Sown May 23, 2003

Variety	2003		
	CP	ADF	NDF
Golden German Millet – foxtail	10	28	52
Barley – Ranger	**7**	**35**	**58**
Oat - AC Pinnacle	10	28	52
Crown millet	9	24	49
39T71 (Pioneer Hybrid)	7	23	48
HLS007 (Prairie seeds)	8	23	45
Mega green Sorgum-sudan grass	11	23	49



(SFC 2001-2003E, SFC-0267-H)
Yellowfeed in Saskatchewan

Summary

Yellowfeed is a harvesting method where an annual cereal crop grown for forage is sprayed with glyphosate at the milk-soft dough stage and allowed to stand until dry. Once dry the crop can be cut and baled immediately following. After the application of Glyphosate, dry matter yield continued to increase for at least 4 days. For as long as 30 days after spraying, there were few cases with loss in yield except under very wet conditions. After spraying the percentage of protein decreased and then remained stable. The percentage of total digestible nutrients was inconsistent after spraying. In dry years it either remained constant or increased, and in a wet year it either remained constant or decreased. Yellowfeed is a viable alternative harvesting method when annual cereals are harvested for hay.

Introduction

Yellowfeed is the name given for a new alternative method of harvesting an annual cereal crop for hay. The traditional method of harvesting annual cereals for hay or greenfeed is to cut and crimp the crop at the milk-soft dough stage, and allow the material to dry in the windrow before baling. With yellowfeed, glyphosate is applied at the milk-soft dough stage and the crop is then allowed to stand until dry. Once dry, the crop can be cut and baled immediately following. Advantages of yellowfeed are: eliminates weathering loss in the windrow during rainy conditions; eliminates the need to turn windrows after a rain; ability to schedule harvest – similar to silage; perennial weed control; crop can be cut

with a swather rather than a haybine. Disadvantages of yellowfeed are: requires a high clearance sprayer; cost of glyphosate; no regrowth for fall grazing.

During 2001-2003, forage samples of oats and barley were collected to determine the effect of glyphosate on yield and quality. Yield and quality were monitored from the time of spraying until 1-2 weeks past the point of being dry enough to cut and bale on the same day. The rate of glyphosate was 1 litre/acre.

Site Locations and Harvest Conditions

In 2001, oats samples were collected from four producer sites at Balcarres, Carievale, Corning, and Francis. Barley samples were collected from one producer site at Wawota. In 2002, oats samples were collected from two producer sites at Corning and Fillmore, and barley samples were collected from one producer site at Wawota. Also in 2002, randomized replicated plots of oats and barley were sampled at the Southeast Research Farm Inc. at Redvers, and at Indian Head Agricultural Research Foundation. In 2003, oats and barley plots were seeded at Redvers and Indian Head.

In 2001 and 2003, there was no rain during the sampling period. The crops were generally dry enough to cut and bale by days 12-15. In 2002 there was an extended period of wet weather after the glyphosate was applied, and the crops required a much longer time to dry. In some cases, the crops were still not dry enough for baling 38 days after spraying.

Forage Yield

Dry matter yield usually increased after the application of glyphosate. The trend was forage yield tended to increase within 15 days after spraying, and then level off. Average yield increases were in the range of 10-15%. The increases occur because the crop continues to grow for a period of time after spraying. When yield reductions occurred, they usually happened after day 15.

In 2001, the yield of oats increased from 4845 Kg/ha on day 0 to 5254 Kg/ha on day 4 (Table 1). Statistically the yield remained constant until day 12 at 5212 Kg/ha. On day 16 the yield returned to 4963 Kg/ha, which is statistically similar to day 0. A statistical analysis could not be applied to the single barley site, but yield followed a trend of increasing to day 11, and remaining constant until day 14.

In 2002, the yield of barley at Redvers remained constant after spraying. The yield of oats increased from 7086 Kg/ha on day 0 to 8294 Kg/ha on day 33 (Table 2). At the producer locations, the yield of oats increased from 3962 Kg/ha on day 0, to 4884 Kg/ha on day 25, and remained statistically constant at 5010 Kg/ha on day 33 (Table 3). A statistical analysis could not be applied to the single barley site, but yield followed a trend of increasing until day 23, and then returning to pre-glyphosate level by day 39. In 2002 at Indian Head, the yield of barley appeared to decline, but the differences were not significantly different (Table 4). The yield of oats was 5241 Kg/ha on day 0. Statistically the yield remained constant at 5670 Kg/ha until day 22, then dropped to 4430 Kg/ha on day 38.

In 2003 at Redvers, the average yield of oats and barley increased from 5918 Kg/ha on day 0 to 6696 Kg/ha on day 30 (Table 5). At Indian Head the average yield of oats and barley increased from 4141 Kg/ha on day 0 to 5063 Kg/ha on day 15, and remained statistically constant to day 26 (Table 6).

Forage Quality

A. Crude Protein

In all years and locations, protein of oats and barley declined from glyphosate application until days 8 to 22, and then leveled off. The protein decline ranged from 0.9 to 3.3 percentage points. This drop in protein percent coincides with an increase in dry matter yield. Therefore, we surmise that a portion of the decrease in percent protein is due to dilution from increased yield, however, further analysis of data will be carried out to clarify this.

In 2001, protein of oats decreased from 8.7% on day 0, to 7.8% on day 4, to 7.1% on day 8, and remained statistically constant thereafter (Table 1). A statistical analysis could not be applied to the single barley site, but protein followed the same trend as the oats.

At Redvers in 2002, the average protein of oats and barley decreased from 9.1% on day 0 to 6.9% on day 33 (Table 2). At the producer sites with oats, protein decreased from 11.1% on day 0 to 8.2% on day 25, and remained statistically constant to day 33 (Table 3). A statistical analysis could not be applied to the single barley site, but protein

followed the same trend of initially decreasing and then remaining constant. In 2002 at Indian Head, protein of barley decreased from 9.3% on day 0 to 7.9% on day 22, and remained statistically constant to day 38 (Table 4). Protein of oats decreased from 11.2% on day 0 to 7.9% on day 22, and remained constant to day 38.

In 2003 at Redvers, the average protein of oats and barley decreased from 8.6% on day 0 to 7.2% on day 10, and remained statistically constant thereafter (Table 5). At Indian Head the average protein of oats and barley decreased from 10.9% on day 0 to 7.7% on day 15, and remained statistically constant thereafter (Table 6).

B. Total Digestible Nutrients (TDN)

The response of TDN to the application of glyphosate was inconsistent and varied among locations and years. During the dry harvest conditions of 2001 and 2003, TDN percent either remained constant or increased by 3.4 percentage points. During the prolonged wet harvest conditions of 2002, TDN remained constant at three sites and decreased at one site by 6.0 percentage points.

In 2001, TDN of oats increased from 59.6% on day 0 to 63.5% on day 12, and remained statistically constant until day 16 (Table 1). A statistical analysis could not be applied to the single barley site, but TDN followed a trend of a small decrease.

In 2002 at Redvers, the average TDN of oats and barley remained statistically constant at 56.3% on day 0, and 53.9% on day 33 (Table 2). At the producer sites with oats, TDN

remained statistically constant at 54% on day 0, and 51.8% on day 33 (Table 3). A statistical analysis could not be applied to the single barley site, but TDN appeared to decline from 60% on day 0 to 54% on day 39. At Indian Head in 2002, the TDN of both oats and barley remained statistically constant at 71.9% on day 0 and 70.4% on day 22, and then dropped to 65.9% on day 38 (Table 4).

In 2003 at Redvers, the average TDN of oats and barley remained statistically constant at 72.6% on day 0 and 68.6% on day 30 (Table 5). In 2003 at Indian Head, the average TDN of oats and barley remained statistically constant at 65.3% on day 0 and 66.6% on day 26 (Table 6).

Conclusions

Yellowfeed appears to be a viable option for drying annual cereals prior to baling. The application of glyphosate does not cause a significant negative effect on forage yield or quality. Forage yield appears to initially increase after spraying, likely due to the crop continuing to grow for a period of time after spraying. Protein percent appears to decline after spraying. This could be due to dilution from increased yield, or it could be a normal decrease in protein level from later maturity. TDN appears to remain constant with variations from small increases to small decreases.

Discussion

Glyphosate products currently registered for pre-harvest use on livestock forage are Credit, Maverick, Vantage, Vantage Plus, Renegade, and Roundup.

After glyphosate, barley dries about 4-7 days sooner than oats. Barley stands well after spraying, but the heads tend to curl over close to the soil surface when the crop is left standing after it has dried. Oats tends to lay over horizontally at about a 12-18 inch height. This does not interfere with cutting because the cutter bar can be set below this height. The leaves and kernels remain attached, even after the crop is left standing 7-10 days after dry.

Palatability of yellowfeed is reported as good. Most producers believe the palatability of yellowfeed is equal to or greater than regular greenfeed.

The economics of yellowfeed could be studied further. Economic analysis should consider: expected changes in forage yield and quality from spraying to harvest; cost of herbicide and application; cost of swathing compared to crimping; potential benefit of perennial weed control. A comparison of yellowfeed and greenfeed could change from year to year based on weather conditions after spraying and cutting. Greenfeed harvest and forage quality losses can be relatively high in years when there is significant rainfall after cutting.

Table 1. Changes in oat yield and quality after the application of glyphosate in 2001			
Days after Spraying	Yield kg ha^{-1} (Dry Matter)	Crude Protein % (Basis Dry Matter)	TDN % (Basis Dry Matter)
0	4845*b*	8.7*a*	59.6*b*
4	5254*a*	7.8*b*	61.6*ab*
8	5313*a*	7.1*c*	61.4ab
12	5212*a*	7.3*bc*	63.5*a*
16	4963*b*	7.6*bc*	63.0*a*

Table 2. Changes in barley and oat yield and quality after the application of glyphosate at Redvers in 2002.					
Barley		Oats		Barley and Oats	
Days after Spraying	Yield kg ha^{-1} (Dry Matter)	Days after Spraying	Yield kg ha^{-1} (Dry Matter	Crude Protein % (Basis Dry Matter)	TDN % (Basis Dry Matter)
0	6935*b*	0	7086*b*	9.1*a*	56.3*a*
33	7090*b*	33	8294*a*	6.9*b*	53.9*a*

Table 3. Changes in oat yield after the application of glyphosate at producer sites in 2002.			
Days after Spraying	Yield kg ha^{-1} (Dry Matter)	Crude Protein % (Basis Dry Matter)	TDN % (Basis Dry Matter)
0	3962*b*	11.1*a*	54
25	4884*a*	8.2*b*	52.8
33	5010*a*	7.8*b*	51.8

Table 4. Changes in barley and oat yield and quality after the application of glyphosate at Indian Head in 2002.			
Barley			
Days after Spraying	Yield kg ha^{-1} (Dry Matter)	Crude Protein % (Basis Dry Matter)	TDN% (Basis Dry Matter)
0	5905	9.3	71.9*a*
16	5137	-	-
22	5866	7.9	70.4*a*
38	5481	8.2	65.9*b*

Oats			
Days after Spraying	Yield kg ha^{-1} (Dry Matter)	Crude Protein % (Basis Dry Matter)	TDN% (Basis Dry Matter)
0	5241*a*	11.2	71.9*a*
16	5359*a*	-	-
22	5670*a*	7.9	70.4*a*
38	4430*b*	7.9	65.9*b*

Table 5. Changes in barley and oat yield and quality after the application of glyphosate at Redvers 2003.

Days after Glyphosate	Yield kg ha^{-1}	Crude Protein	TDN
0	5918*b*	8.6*a*	72.6*a*
10	6365*ab*	7.2*b*	70.4*a*
20	6274*ab*	6.3*b*	63.0*a*
30	6696*a*	7.0*b*	68.6*a*

Table 6. Changes in barley and oat yield and quality after the application of Glyphosate at Indian Head 2003.

Days after Glyphosate	Yield kg ha^{-1}	Crude Protein	TDN
0	4141*b*	10.9*a*	65.3*a*
15	5063*a*	7.7*b*	65.3*a*
26	4879*a*	7.4*b*	66.6*a*

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Cool Season Warm Season Annual Forage Trial – 2003

Summary

Cool and warm season annuals were seeded at Redvers, Indian Head, Canora, Melfort, Swift Current and Scott to compare forage yield and quality. Two seeding dates, eleven crops and two harvest times were used. The crops in this trial have significant differences in maturity. As expected, dry matter yield of the cool season annual cereals (oats, barley) tended to decrease with the later seeding date. However, seeding date did not have a consistent effect on the yield of the warm season annuals (Golden German millet, Crown millet, Siberian Red millet, Strain R German millet, White Wonder foxtail millet, Pearl millet, sorghum-sudangrass, corn). Corn had the highest yield, while the yields of barley, Golden German millet, oats, and crown millet were not statistically different from each other. The second harvest, at 6970 Kg/ha, had significantly higher yield than the first harvest, at 6540 Kg, when averaged over all crops and locations, and both seeding dates. Crude protein tended to increase when seeding was delayed and decrease when the crop was harvested at a later stage. Weathering in the windrow until December had very little effect on the crude protein. Total digestible nutrients were not affected by seeding date or harvest time, however, when samples were left to weather in the windrow and averaged across all locations, the earlier maturing crops (oats, barley, Crown millet) had statistically significant declines in TDN from second harvest to the December sample. At the eastern Saskatchewan sites, the late maturing millets appear better suited than oats and barley for swath grazing.

Introduction

This research project is poised to answer the much-debated issue of the adaptive quality and potential for warm season crops as annual forages in Saskatchewan. In some areas, warm season crops tend to outperform cool season crops for forage production (Vanin, unpublished). Studies conducted at the Brandon Research Centre have chronicled warm season crops advantages over cool season in dry matter production, especially for swath grazing (Byron Irvine, pers.comm.). Earlier studies evaluating old generation warm season grasses for greenfeed and silage have dissuaded their production in Saskatchewan. The availability of new species and varieties of warm season grasses has reopened this question especially for use in a swath grazing system. If the provincial agricultural community is aiming to increase its cattle herd population, new innovative ideas need to be researched to provide farmers with the best information for feed production. Perennials serve as the corner post of the livestock production system, but annuals can provide supplemental and emergency forage production. The objective of this study is to evaluate annual forage species for adaptation, quality, and yield production in annual forage and swath grazing systems.

Methods

Cool and warm season annuals were seeded at Redvers, Indian Head, Canora, Melfort, Swift Current and Scott. The cool season crops seeded were AC Pinnacle oats and AC Ranger barley. The warm season crops were Crown millet, Golden German millet, Forage King sorghum-sudangrass, and Pioneer 39T71 corn. In addition, Siberian Red millet, Strain R German millet, White Wonder foxtail millet, and Mil Hy 300 Pearl millet were seeded at Redvers, Indian Head and Canora.

The plots were seeded in a split plot design with four replications. A complete set of plots was seeded mid May and again in mid June. It was expected the mid May seeding date would favour the cool season species, and the mid June seeding date would favour the warm season species.

Fertilizer was side banded during seeding at 50 lbs/acre nitrogen and 20 lbs/acre phosphorus. Two plots of corn were seeded; one at the above fertilizer rate, and a second with additional nitrogen at 120 lbs/acre and double wide row spacing.

Samples for forage yield and quality were collected on two separate dates from each plot to help determine the optimum crop stage for harvesting. The first samples were collected at milk dough for oats, soft dough for barley, 50% milk line for corn, and 2-3 weeks after heading for the millets and sorghum-sudangrass. The second samples were collected 2 weeks after the first sample.

To determine the suitability of the crops for swath grazing, a third set of samples for quality analysis were collected in December. These were collected from the mid June seeded plots that were windrowed after the second yield samples were collected. December samples were not collected for Siberian Red, Strain R, White Wonder, and Pearl millet.

Forage quality samples were analyzed at Norwest Labs in Lethbridge using wet chemistry FD6N package.

Results

Precipitation

Table 1 lists general spring moisture reserves and monthly precipitation at each site from April to August inclusive. With the exception of Scott, moisture reserves in spring were good to excellent. Precipitation from April to August was below average at all sites.

Maturity

The crops in this trial have significant differences in maturity, and the days to heading are affected by seeding date. Crops seeded in mid June require fewer days to head than those seeded in mid May. Of the warm season crops, Crown millet is the earliest to head at 50-60 days. Siberian Red millet heads at about 65-70 days. Golden German and White Wonder millet head at about 75-90 days. Strain R, Pearl millet and sorghum-sudangrass are the latest to head at about 80-95 days.

Forage Yield

a) Location and Crop

Averaged over all locations, both seeding dates, and both harvest times, corn had the highest dry matter yield at 9180 Kg/ha with high nitrogen and 9050 Kg/ha with regular nitrogen (Table 2). The yields of barley, Golden German millet, oats, and crown millet were statistically similar at 6610, 6480, 5990, and 5930 Kg/ha respectively. The yield of Sorghum-sudangrass was 4070 Kg/ha, statistically similar to oats and Crown millet, but lower than barley and Golden German millet.

Table 3 lists the yield of individual crops at each location, averaged over both seeding dates and both harvest times.

At Canora the highest yielding crops with statistically similar values were Crown, Golden German, Siberian Red, Strain R, and White Wonder millets. Barley and sorghum-sudangrass were slightly lower yielding, with oats and pearl millet the lowest. The corn plots were not sampled at Canora.

At Indian Head the highest yielding crops with statistically similar values were barley, Golden German millet, and corn with regular and high nitrogen. Oats and Siberian Red millet were slightly lower yielding. Strain R and White Wonder millet had intermediate yield, Crown and sorghum-sudangrass were lower, and Pearl millet yield was poor.

At Melfort the highest yielding crop was corn with high nitrogen. Oats, barley, Golden German millet and corn with regular nitrogen were intermediate yielding with statistically similar values. Crown millet was slightly lower yielding, and sorghum-sudangrass was significantly lower.

At Redvers the highest yielding crop was corn with regular and high nitrogen. Barley, Golden German, Siberian Red, Strain R, and White Wonder millet were intermediate yielding with statistically similar values. Oats and Crown millet were slightly lower, sorghum-sudangrass was significantly lower, and Pearl millet was poor.

At Scott the highest yielding crop was corn with high nitrogen. Corn with regular nitrogen was statistically lower. Oats, barley, Crown and Golden German millet were intermediate yielding with statistically similar values. The yield of sorghum-sudangrass was relatively poor.

At Swift Current the highest yielding crops with statistically similar values were oats and barley. Crown and Golden German millet were intermediate yielding. Sorghum-sudangrass, regular nitrogen corn and high nitrogen corn had the lowest yields.

b) Seeding Date

As seeding date was delayed from mid May to mid June, the trend at most sites was a decrease in yield. Averaged over all crops and locations, and both harvest times, the mid

June seeding date yield of 6580 Kg/ha was lower but statistically similar to the mid June seeding date yield of 6940 Kg/ha.

Averaged over all crops and both harvest times, the yield reductions at each site from mid May seeding to mid June seeding were: Canora 20%, Indian Head 10%, Melfort 21%, Scott 15%, Swift Current 17%. At Redvers yield increased 6% with the mid June seeding date. The yield decreases at Canora, Melfort and Swift Current were statistically significant. The yield differences at Indian Head, Scott and Redvers were not statistically significant.

As expected, yield of the cool season crops (oats, barley) tended to decrease with the later seeding date. The decrease with mid June seeding ranged from 0-27%. At Swift Current there was an extreme yield decrease of 50%. This trend follows a general rule for cool season crops that states for each week seeding is delayed past May 25, expect a 10% reduction in yield.

Seeding date did not have a consistent effect on the yield of warm season millets (Golden German, Crown, Siberian Red, Strain R, White Wonder). This result was expected as warm season crops have a higher optimum growing temperature (32-35°C) compared to cool season crops (18-24°C). Also, warm season crops are more water efficient in warm temperatures. It appears millets can be seeded any time after minimum daily soil temperature, usually in early morning, has reached 10°C. This ensures relatively fast and uniform germination and crop establishment.

The ability to delay seeding warm season millets to early June, without sacrificing yield, is ideal for swath grazing. With early June seeding, later maturing millets can be windrowed just prior to killing frosts in September. Relatively cool temperatures in fall reduce the risk of feed weathering in the windrow.

Corn reacted somewhat different than the millets to seeding date. Corn seeded mid May at Indian Head and Melfort had higher yield than corn seeded mid June. Early seeded corn at Indian Head and Melfort also responded to high nitrogen and wide rows. At Scott the late seeded corn at high nitrogen had the highest yield.

c) Harvest Time

Averaged over all crops and locations, and both seeding dates, the second harvest at 6970 Kg/ha had significantly higher yield than the first harvest at 6540 Kg/ha. This commonly occurs with annual forages, especially when moisture is available. At individual locations, the yield increase from first to second harvest was: Canora 6%, Indian Head 16%, Melfort 20%, Redvers 9%. All of the yield increases were statistically significant.

Conversely, yield decreased 7% at Scott and 18% at Swift Current from first to second harvest. These yield decreases were statistically significant. The majority of the loss at both locations occurred in oats and barley. At Scott, the lower yield with second harvest was likely due to a very high infestation of grasshoppers that fed on the plots. At Swift Current, the yield decrease was likely due to harvest method. The plots were harvested

with a flail mower that may have threshed and lost a significant amount of oats and barley kernels.

The crop stage at first harvest was milk dough for oats and soft dough for barley. These are the recommended stages for greenfeed to optimize forage yield, quality and palatability. The second harvest for oats and barley was two weeks later, and in most cases they were too mature for greenfeed. Therefore, analysis of the data should focus more on the first harvest for oats and barley.

First harvest for the late maturing millets (Golden German, Strain R, White Wonder) was 2-3 weeks after heading, and second harvest was 2 weeks later. At second harvest the late maturing millets had remained quite green. It appears the second harvest may be the optimum time to harvest these crops.

The yields of first harvest oats and barley were compared to second harvest Golden German millet. At Redvers, Indian Head and Canora, second harvest Golden German millet was 15-40% higher yielding than first harvest oats and barley. At Melfort there was not a consistent difference. At Scott and Swift Current, second harvest Golden German millet was 25-45% lower yielding than first harvest oats and barley.

Crude Protein

a) Location and Crop

There was significant variation among the locations with Scott having high protein levels and Swift Current having low protein levels (Table 3). At Indian Head, Melfort and Redvers, corn had the lowest level of protein. At Scott corn had the lowest protein, but the levels were statistically similar to barley and Golden German millet. At Swift Current all of the crops were relatively low in protein. Only oats had a higher protein level than the corn.

The protein requirements for beef cows, basis dry matter are 7% in second trimester, 8% in third trimester and 10% post calving. Excluding Swift Current, all of the crops are 8% protein or greater, with the exception of corn. Corn tends to be marginal for protein and it may need to be supplemented, especially as cows are getting closer to calving.

b) Seeding Date

Averaged across all crops, harvest times and locations, protein increased from 8.8% at mid May seeding to 9.4% at mid June seeding. This increase was not statistically significant.

c) Harvest Time

Averaged across all crops, seeding dates and locations, protein decreased from 9.9% at first harvest to 8.3% at second harvest. This decrease was statistically significant. At first harvest, corn had lower protein than all other crops. At second harvest, corn had lower protein than all crops except barley (Table not included).

d) Winter Quality for Swath Grazing

The plots seeded in mid June were windrowed after the second harvest. The windrows were left in the field to simulate swath grazing, and sampled in December for quality analysis. Averaged across all locations, protein levels were maintained for all crops from second harvest to December (Table 4). This is consistent with previous swath grazing work that monitored feed quality in the windrow from September to December. It appears there is minimal risk of losing protein when leaving windrows in the field starting in September.

Total Digestible Nutrients (TDN)

a) Location and Crop

TDN levels varied across locations and among crops with no apparent trends. For example, relative to the other crops, barley at Canora had the highest TDN, while at Redvers it had a low TDN.

The TDN requirements for beef cows, basis dry matter are 50% in second trimester, 55% in third trimester, and 60% post calving. With one exception of Golden German millet at Canora, TDN for all crops at all locations is 55% or greater. There are few cases where TDN is less than 60%.

b) Seeding Date

Averaged across all crops, locations and harvest times, TDN remained statistically constant at 66.3% for mid May seeding and 67.5% for mid June seeding.

c) Harvest Time

Averaged across all crops, locations and seeding dates, TDN remained statistically constant at 67.2% for first harvest and 66.6% for second harvest. Barley was the only crop to show a statistically significant loss in TDN from 67.5% at first harvest to 63.5% at second harvest.

d) Winter Quality for Swath Grazing

The plots seeded in mid June were windrowed after the second harvest. The windrows were left in the field to simulate swath grazing, and sampled in December for quality analysis. Averaged across all locations, the earlier maturing crops (oats, barley, Crown millet) had statistically significant declines in TDN from second harvest to December (Table 4). The TDN losses were: oats 66.1% to 58.7%, barley 63.7% to 59.4%, Crown millet 67.9% to 61.3%. TDN of Golden German millet, sorghum-sudangrass and corn remained statistically constant from second harvest to December. The late maturing warm season crops appear to have the ability to maintain quality into winter, making them suited for swath grazing.

Discussion and Conclusions

Oats and barley are not ideally suited for swath grazing. To maximize yield under normal conditions, oats and barley need to be seeded May 20-25 to take advantage of

spring moisture and cooler temperatures. When they are seeded this early for swath grazing, they will have to be cut in early August. Windrows left in the field from early August to freeze-up are subjected to long daylight and warm temperatures with potential for significant weathering. Seeding can be delayed to mid June to delay cutting, but there is a high probability yield will be reduced. As a general rule, for each week that seeding is delayed past May 25, expect a 10% loss in yield.

The native tall grass prairie region of western Canada stretches through central Manitoba, including the Red River Valley and wide bands on either side. Before European settlement, the tall grass prairie was dominated by Big Bluestem (Andropogon gerardii), a warm season grass.

Of the trial sites, Redvers, Indian Head and Canora are geographically the closest to the Red River Valley. These sites showed Golden German millet had a significant yield advantage over oats and barley. It may be these sites have a climate that favours warm season crops more than sites in western Saskatchewan.

In eastern Saskatchewan, later maturing millets such as Golden German, Strain R German and White Wonder appear to be suited for swath grazing. Seeding of warm season crops needs to be delayed until early June when the soil has warmed to a minimum daily soil temperature of 10°C. Because of later maturity and tolerance to warmer temperatures, the crops remain green and continue to grow late in the season. They can be cut in early-mid September, just prior to a killing frost. There is little risk of weathering in the windrow due to short day length and cool temperatures.

Overall, corn was the highest yielding crop in the trial. However the relatively high price of corn seed requires a significantly higher yield to justify the cost of production. The seed costs of the millets and sorghum-sudangrass have been higher but relatively close to the costs for oats and barley. Future work with corn will need to factor in the price of seed to determine if corn is an economical forage alternative.

Research at Brandon Research Centre has found advantages for late maturing millets. Many producers in eastern Saskatchewan have also had good results. A similar trial in 2002 at Redvers, Indian Head and Canora, had similar results to this trial in 2003. This trial will continue in 2004 at Indian Head, Canora and Scott. A final report will summarize 3 years of data.

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Table 1. 2003 Precipitation (mm) and Soil Moisture Conditions in Spring						
	Redvers	**Indian Head**	**Canora**	**Melfort**	**Swift Current**	**Scott**
Soil Moisture Reserves (Spring)	**Very Good**	**Very Good**	**Excellent**	**Good**	**Good**	**Poor**
April	19	55	15	28	52	5
May	50	24	32	45	42	16
June	35	18	29	52	79	34
July	27	23	61	36	8	66
August	36	11	9	24	21	44
TOTAL	167	131	146	185	202	165
Percent of Average	64	50	66	89	86	80

Table 2. Dry matter yield averaged across locations, seeding dates, and harvest times.	
Crop	**Dry Matter Yield Kg ha^{-1}**
Corn – high nitrogen	9180*a*
Corn – regular nitrogen	9050*a*
Barley	6610*b*
Golden German millet	6480*b*
Oats	5990*bc*
Crown millet	5930*b*
Sorghum-sudangrass	4070*c*

Table 3. Yield, Crude, Protein and Total Digestible Nutrients by location

Location	Pinnacle Oats	Ranger Barley	Crown Millet	Golden German Millet	Forage King Sorghum-Sudangrass	Corn	Corn (wide row/high N)	Siberian Red Millet	Strain R German Millet	White Wonder Foxtail Millet	Mil Hy 300 Pearl Millet
Yield (kg ha^{-1})											
Canora	6990*cd*	9540*bc*	11110*ab*	11560*ab*	9360*bc*			10440*ab*	12830*a*	11690*ab*	5010*d*
Indian Head	4810*bcd*	5620*a*	3420*ef*	5100*ab*	3260*f*	4960*abc*	5620*a*	4870*bc*	4140*de*	4310*cd*	1430*g*
Melfort	8680*b*	9500*b*	7270*c*	8930*b*	4530*d*	9530*b*	12080*a*				
Redvers	5910*cd*	6610*bc*	5590*d*	6880*b*	4520*e*	9280*a*	8830*a*	6260*bcd*	6480*bcd*	7080*b*	2860*f*
Scott	5450*c*	5940*c*	6330*c*	5180*c*	2900*d*	11420*b*	13660*a*				
Swift Current	4340*a*	3940*a*	2520*bc*	2980*b*	1240*d*	2120*c*	1340*d*				
CP (%)											
Canora	9.7*ab*	9.4*b*	10.1*ab*	9.0*b*				8.7*b*	11.2*a*	8.9*b*	
Indian Head	10.7*c*	9.4*d*	11.1*bc*	10.8*c*	11.4*bc*	7.4*e*	8.2*e*	9.5*d*	12.0*b*	10.7*c*	16.9*a*
Melfort	9.0*a*	9.7*a*	9.4*a*	9.5*a*	8.9*a*	7.0*b*	7.7*b*				
Redvers	9.5*b*	7.9*cd*	8.1*c*	8.2*bc*	8.3*bc*	5.7*e*	6.6*de*		8.9*bc*	8.0*c*	11.5*a*
Scott		12.7*bc*	13.4*b*	12.5*bc*	15.8*a*	10.8*c*	11.4*bc*				
Swift Current	8.9*a*	7.2*b*	5.9*cd*	6.7*bc*	5.4*d*	6.5*bcd*	6.8*bc*				
TDN (%)											
Canora	65.5	69.0	63.9	53.8				58.7	60.4	55.0	
Indian Head	71.5	66.7	69.3	69.1	70.1	68.9	69.4	65.3	71.5	66.2	72.0
Melfort	66.6	68.3	69.7	71.8	75.6	70.8	71.2				
Redvers	65.2	60.5	63.6	61.7	64.3	67.5	67.1		63.1	61.9	59.8
Scott		67.9	74.4	70.6	73.7	69.7	69.8				
Swift Current	62.6	60.6	64.4	68.0	56.6	66.1					

Table 4. Effect of sample time on forage quality, averaged across locations.

	Sample Time			
Crop	**First Harvest**	**Second Harvest**	**December**	**LSD $_{0.05}$**
CP (%)				
Pinnacle Oats	11.7	9.2	8.9	
Ranger Barley	10.5	8.4	9.1	
Crown Millet	10.8	9.0	7.8	
Golden German Millet	10.6	9.8	10.3	1.4
Forage King Sorghum-Sudangrass	10.7	9.4	9.5	
Corn	8.0	7.5	8.2	
Corn (wide row/high N)	9.0	8.4	9.0	
Mean	10.2	8.8	9.0	0.8
TDN (%)				
Pinnacle Oats	68.4	66.1	58.7	
Ranger Barley	67.7	63.7	59.4	

Crown Millet	67.7	67.9	61.3	
Golden German Millet	66.5	67.3	67.5	5.3
Forage King Sorghum-Sudangrass	70.2	68.1	66.8	
Corn	68.5	68.6	70.5	
Corn (wide row/high N)	68.5	68.8	70.5	
Mean	68.2	67.2	65.0	3.8

ADF Project SFC-0267-L Maintenance of Perennial Forage Plots, ECRF Canora

The perennial forages were trimmed up this summer for demonstration. The plots were toured by some interested producers during the annual ECRF field day in July. The plots have become weedy limiting their value as a demonstration. Rouging was done in early June. One half of the plots were cut and bailed to demonstrate regrowth as compared to the full height of the plants. In August the plots were cut and bailed. These plots will need to be assessed in the spring of 2004 to look at weed control and / or replacement with other plots.

ADF project SFC-0267-L Pastures Legume demonstration at ECRF, Canora.

The Kura clover trial for 2003 was the establishment of a stand for a termination study. The plot size is 100' x 200'. Seeding rate was 8 #/ac, seeded at 0.25 to 0.5". Fertility for this trial was set at 50 #P, 20 #K and 20 #S side banded. This also delivered 30 #N due to the makeup of the products. The plot was sprayed once in early June with Cobutox 600 @ 0.93 L/ac. Plant establishment was marginal in 2003 but will be further evaluated in the spring of 2004. weed control may likely have to be undertaken again in 2004. The original proposal for this project was written by Thom Weir and is attached below.

Kura clover proposal by Thom Wier

Background: The establishment of legume forage is often unsuccessful. Kura clover (*Trifolium ambiguum*), is an extremely persistent forage legume that originated in Eastern Europe and Western Asia. The characteristic that makes kura clover unique among the forage legumes adapted to the northern prairies is its massive rhizome (underground stem) system. Kura clover persistence is probably associated with the rhizome system having large numbers of buds at various depths in the soil. When portions of plants are damaged by cattle, machinery, or freezing, new growth is initiated from buds on undamaged, underground portions of the plant. It has been shown that individual kura clover plants can creep by rhizome growth to a diameter of three feet over a three-year period, if not competing with other plants (Albrecht and Kim, 1998).

Kura clover is a very leafy plant with vertical stem production occurring primarily only in the first spring growth. During the rest of the season, leaves are produced from compressed stems or directly from rhizomes. Because of the high proportion of leaves in kura clover forage, it has excellent forage quality with protein concentrations ranging from 18 to 25% and neutral detergent fiber concentrations between 25 and 40% (Kim, 1996). Thus the forage quality of kura clover is greater than other traditionally grown legumes.

This combination of excellent persistence, ability to spread by rhizomes to occupy open areas, and excellent forage quality make kura clover an attractive candidate for use as permanent ground cover as a living mulch in a wheat production system, and as a pasture or hay crop in alternate years.

Objective: To determine whether kura clover that has been suppressed with herbicides or tillage could accommodate a year of wheat production, followed by a return to hay or pasture production without replanting. Treatments that will be evaluated included wheat planted into established kura clover that has been: (1) killed with glyphosate and dicamba and fertilized with 50 lb. N/acre, (2) same as (1) but without N, (3) suppressed with low rate of glyphosate and fertilized with 50 lb. N/acre, and (4) same as (3) but without N, (5) suppressed with cultivation and fertilized with 50 lbs N/ acre and (6) same as (5) but without N. An untreated kura clover area will also be included in the experiment to compare with recovery of forage production the year after suppression treatments have been applied. All treatments will be made in the fall to a kura clover plot that was seeded in the spring of 2003. Wheat will be sown into the various treatments with a no-till drill in the spring of 2005. A treatment will also be seeded into fallow.

One of the major opportunities that may result from this work would be to provide an effective rotation for organic producers. The cultivation of the kura clover would (a) provide nitrogen through a green plowdown and (b) provide reduction of weeds. The regrowth in the wheat crop would provide competition for weeds as well as providing hay or grazing the fall and following year.

The project would be duplicated the following year on the remainder of the plot that would then be 3 years old.

Reference: Corn Production in a Kura Clover Living MulchKenneth A. Albrecht, Robert A. Zemenchik, Chris M. Boerboom,Richard P. Affeldt and Palle Pedersen
Department of Agronomy University of Wisconsin-Madison

http://www.ampacseed.com/cornproductioninkura.htm

Albrecht, K.A. and B.W. Kim. 1998. Rhizome development of kura clover. p. 15. Proc. 15th Trifolium Conference.

2003 Report: Collaboration with the Southwest Forage Association
Date: January 31, 2004

Project Title: 98502 Southwest Forage Association demonstration trial comparing AC-Grazeland alfalfa verses AC-Grazeland+Sainfoin.

Principal Investigator: Southwest Forage Association (SWFA)
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Abstract
The potential benefits of grazing alfalfa (*Medicago sativa* L.) are well documented (e.g., high yields and forage quality, excellent animal gains) and thus, many livestock producers are interested in its use. However, alfalfa's ability to cause bloating in cattle and potential death has caused many livestock producers to not consider grazing pure alfalfa stands or only alfalfa/grass mixtures in which the alfalfa constitutes less than 20% of the forage stand. The recent availability of AC-Grazeland (AC), a low bloat causing alfalfa cultivar, and the use of non-bloating legumes in mixture with alfalfa are reported grazing strategies to reduce the occurrence of bloating and may be a method to increase the ability to graze alfalfa in the pasture at higher proportions. The objective of this study was to evaluate the bloating potential or bloat reducing potential and animal grazing performance of AC verses a mixed AC and sainfoin (AC+S) pasture. In 1998, one pasture (4.9 ac) was seeded to AC, while another pasture (4.4 ac) was seeded to an AC+S mixture. Seeding rate for the AC and sainfoin (S) were 5 and 38 lbs per acre, respectively. Grazing of the two pastures were initially started in 2000 by an equal number of yearling steers. Grazing and forage data from 2002 and 2003 were used in this study. Yearling steers commenced grazing on the AC pasture at the early bud stage and the S was grazed at the early flower stage. Each steer on the AC pasture received a rumensin CRC bolus, while steers on the AC+S received no rumensin boluses. Results found that no bloating or bloat symptoms were observed in the cattle grazing from either forage

treatment in 2002 and 2003. Average daily gains and total live production did not differ ($P > 0.13$) between pasture treatments. Further research is needed to evaluate longevity of AC and AC+S pastures under different grazing management for southwest Saskatchewan.

Introduction

Alfalfa (*Medicago sativa* L.) is the oldest known domesticated forage and historically has been used for more than 3,300 years. The potential benefits of grazing alfalfa are well-documented (high yields and excellent forage quality) and thus many livestock producers are interested in its use. However, proper grazing management and preventing bloat are two of the challenges when grazing alfalfa. Various strategies have been attempted to minimize potential bloat concerns, such as: pasture management and diet manipulation (alfalfa/grass mixture, a stage of maturity etc.), anti-bloating and feed additive compounds (detergents, Blocare 4511, rumensin, etc.), bloat reduced alfalfa cultivar (AC-Grazeland) and non-bloating legumes. The use of alfalfa/grass mixtures has been the most practical bloat prevention measure for beef cattle production in Western Canada but may not always be effective.

To reduce potential alfalfa bloat concerns the use of AC-Grazeland (AC), a newly licensed low bloat variety of alfalfa has been developed and may provide a forage tool that will allow for safer grazing of alfalfa by cattle. It is important to remember that AC is not bloat free, but rather decreases the frequency and severity of acute bloats. The lower potential for bloat is a result of a reduce initial rate of digestion of the AC. Research out of Agriculture and Agri-Food Canada in Kamloops reported a reduction in bloat incidence ranging from 40 to 88% on grazing trials on range pastures. As well, the severity of bloat was reduced, as indicated by the almost complete absence of multiple distensions of the rumen per animal per day grazing AC (Majak et al. 1998).

Every cultivar of alfalfa tested can cause bloating, but sainfoin (*Onobrychis viciifolia*), birdsfoot trefoil (*Lotus corniculatus*) and cicer milkvetch (*Astragalus cicer*) do not, confirming the bloat-safe features of these alternate legume forages (Majak et al. 1995). There has been interest in grazing interseeded mixed stands of alfalfa and sainfoin (S). Researchers at Lethbridge and Kamloops have shown that bloat concerns were greatly reduced when S+alfalfa mixtures were grazed by cattle. Thus, it may be possible to control alfalfa bloat concerns by adding a little S to the forage mix. Researchers have reported that 15 to 20% S in a mix should be enough to supply the tannins needed to control bloating (McAllister personal communication 2004). However, S has never gained popular acceptance as a pasture ingredient because of its reported poor seed emergence, high seed costs, less than adequate hay production and short stand life (Jefferson et al. 1994).

More in depth review of the efficacy of ionophores in the control of legume bloat has been reported by Hall and Majak (1989). However, these feed additives, which are also antibiotics, have the potential to reduce the incidence of bloat by more than 50% but they do not prevent the occurrence of legume bloat. The CRC (antibiotic feed additive) ionophore increases the molar proportion of propionic acid and decreases methane production and as a result there is an improvement in the efficiency of energy utilization by the animal. Why the CRC ionophore helps reduce the incidence of bloat is not clearly understood but it may be related to shift in rumen bacteria population, rumen fermentation and inhibiting proteolysis (i.e., protein digestion).

Objective

The objective of this study was to evaluate the bloating potential or bloat reducing potential and animal grazing performance of AC verses a mixed AC+S pasture.

Materials and Methods

In July of 1998, two pastures rented to the SWFA were seeded. Pasture one was 4.4 ac (1.8 ha) in size and was seeded to an AC and S mixture. The AC was seeded at 5 lb ac^{-1} (5.6 kg ha^{-1}) and the S at 38 lb ac^{-1} (42.6 kg ha^{-1}). The AC was seeded in a 12 in (30 cm) row spacing and the S was seeded in between the AC rows. Pasture two was 4.9 ac (2.0 ha) in size and was seeded only to AC at 5 lb ac^{-1} (5.6 kg ha^{-1}). Grazing of these pastures first occurred in 2000 and grazing measurements were also taken in 2002 and 2003. Due to the drought conditions experienced in Southwest Saskatchewan in 2001, both pastures were not grazed. During the 2000 grazing season all 24 steers (817 ± 26 lb) were orally implanted with a rumensin CRC bolus. Twelve steers were randomly allocated to each of the pastures. Twenty four steers were also used in the 2002 (776 ± 17 lb) and 2003 (827 ± 27 lb)grazing seasons with 12 steers randomly placed on each pasture. However, ionophores were not implanted into all steers and only steers grazing the AC received CRC boluses. For all three grazing seasons, grazing commenced when the AC forage was at the early to late bud stage and the S was at the early flower stage (Fig. 1) (Fick and Mueller 1989).

Figure 1. AC at the early to late bud stage and yearling steers grazing AC+S.

For the 2000, 2002 and 2003 grazing season, initial and final steer weights were recorded after a 12 hr shrink for both the initial and re-growth grazing period for the two pastures. Animal production values [average daily gains (ADG), total livestock production (TLP) and grazing days per acre] were calculated using adjusted initial and final steer weights. Standard methods to measure available and total forage yields using 0.25 m^2 quadrats (five per pasture) and cage enclosures (three per pasture) were conducted (Cook and Stubbendick 1986). In 2000, 2002 and 2003 forage quality compositions (five random samples per pasture) were measured (%OM, %OMD, %ADF, %NDF, %CP and total phosphorus) for each pasture. The experimental design was completely randomized with years as replicates and the treatment effects (AC and AC+S) analysed using the GLM procedure of SAS.

Results and Discussion

Steer grazing performances for 2000, 2002 and 2003 are found on Tables 1. In 2000, similar animal performances were observed for both pastures. Steer average daily gains for both pastures were more than 4.0 lb d^{-1} (1.8 kg d^{-1}), which was higher than expected. Animal performances in 2002 and 2003 were more inline to what was expected (i.e., ADG of 2.0-3.6 lb d^{-1}) and similar to other research studies (Berg 2000). Average daily gains and TLP did not differ ($P>0.13$) between the two pastures. However, ADG and TLP measurements were consistently higher for the AC+S pastures verses AC. This was unexpected, especially since the steers on the AC were orally implanted with CRC rumensin boluses and were expected to perform better than the steers on the AC+S pasture. It is unclear why these results were observed. Studies have reported that S contains tannins which can form insoluble complexes with proteins that are later released and digested and absorbed in the small intestine (Kraiem et al. 1990). In addition, S has higher energy levels (i.e., sugars and carbohydrates) than alfalfa and this can result in increase consumption and conversion (Glover 1980). Improved animal performance may be due to better utilization of the AC+S protein content as a result

of increases rumen bypass protein and/or better utilization of the ammonia produced in the rumen by the rumen microbial population due to the higher energy supplied by S. Further research is needed to elucidate the potential benefits of S when in a forage mix. Grazing days per ac did not differ (P = 0.86) between the two pastures. Re-grazing results for 2000 and 2002 on the pasture re-growth were not analysed due to the shortness of the grazing period and the high standard deviation associated with the mean initial and final steer weights.

Table 1. Grazing Performance of Yearling Steers Orally Implanted with (+CRC) or without (-CRC) Rumensin Boluses on AC-Grazeland (AC) and AC+Sainfoin (AC+S) Pastures.

Pasture and grazing season	CRC rumensin bolus	Average daily gain (lb ac^{-1})	Total live weight production (lb ac^{-1})[1]	Grazing days ac^{-1}
2000 (June 19 to 29)				
AC	+CRC	4.2	176.4	42.0
AC+S	+CRC	4.1	188.6	46.0
2002 (June 18 to July 4)				
AC	+CRC	2.8	110.3	39.1
AC+S	-CRC	3.6	158.1	43.4
2003 (June 5 to 24)				
AC	+CRC	2.0	96.6	48.8
AC+S	-CRC	3.0	128.0	43.4

Grazing day per acre = (number of grazing days x steers)/total acreage.
[1] Total live weight production = average daily gain x grazing days per acre (Schellenberg et al. 1999).

Forage yields and qualities for 2000, 2002 and 2003 are found on Tables 2 and 3. Lower than expected available forage yields in 2002 for AC and AC+S pastures were due to the drought conditions experienced in 2001 and the dry and cool spring of 2002. Peak forage yields (sampled in July) in 2002 were closer to what was expected and this was a result of the abundant rainfall that was received later in the season. Available and peak forage yields in 2003 for AC and AC+S pastures were also good due to the good spring and early summer moisture conditions experienced in 2003. Both available and peak forage yields measurements did not differ (P > 0.76) between the two pastures. Forage quality measurements between the two pastures were similar (Table 3). As expected %CP and fibre values for the S when compared to AC were lower and higher, respectively. Unfortunately, forage quality measurements for 2003 for all pastures were not analyzed yet. In 2000 and 2003 the S portion of the AC+S pasture was grazed heavily, with utilization levels greater than 80%. Ditterline and Cooper (1975) reported that S is very palatable and animal prefer it to other legumes, as a result of this animals tend to overgraze the S in a mixture which support our observations. The poor utilization of AC and S in 2002 was due to the drought conditions experienced in 2001, which left stemmy old dry growth in the sward.

Table 2. Forage Production for AC-Grazeland (AC) and AC+Sainfoin (AC+S) Pastures for the 2000, 2002 and 2003 Grazing Season[1].

Pasture and grazing season	Available yield (lb ac^{-1})	Peak yield (lb ac^{-1})	% Pasture utilization
2000			
AC	2623	2400	54.9

AC mix	1472	1538	59.4
S mix	218	66	85.6
2002			
AC	986	1429	35.5
AC mix	736	2069	32.1
S mix	80	93	48.5
2003			
AC	2505	2829	47.6
AC mix	1990	2549	42.4
S mix	260	48	83.8

[1]Available yields were harvested in June when the alfalfa and sainfoin were at the early-late bud and early flower stages, respectively. Peak yields were harvested at the end of July when the alfalfa and sainfoin were at full flower stages.

Table 3. Forage Quality for AC-Grazeland (AC) and AC+Sainfoin (AC+S) Pastures for the 2000 and 2002 Grazing Season[1, 2].

Pasture and sample site	%OM	%OMD	%ADF	%NDF	%CP	%Total P
2000						
AC	90.0	66.8	22.6	28.3	17.3	0.16
AC mix	90.0	67.3	20.9	26.2	18.2	0.16
S mix	92.7	61.5	19.7	23.4	14.8	0.18
2002						
AC	90.0	69.2	23.8	28.7	22.4	0.27
AC mix	90.1	69.6	21.6	26.2	22.0	0.27
S mix	NA	NA	15.2	25.8	20.6	0.25
2003						
AC	90.4	67.6	NA	NA	18.4	0.18
AC mix	90.3	68.5	NA	NA	17.5	0.19
S mix	91.6	60.6	NA	NA	17.6	0.23

[1]Forage quality measurements were done on the available forage yields.
[2]Organic matter (OM), organic matter digestibility (OMD), acid detergent fibre (ADF), neutral detergent fibre (NDF), crude protein (CP), total phosphorus (TP) and NA = results not available.

Alfalfa is considered to be more bloat provocative when it is immature. Berg et al. (1996) observed severe bloats occurring on lush, immature alfalfa forages. All AC forages grazed in 2000, 2002 and 2003 were at the early to late bud stage, and therefore had the greatest potential to cause bloating symptoms. In addition, the 2000, 2002 and 2003 grazing seasons had frequent rainfalls, often making forage material lush and wet. The above mentioned conditions should have made the potential for bloating to occur more likely. However, for all study years, only a few cattle were observed with slight distensions and no cattle were treated for bloating. In the 2000 grazing season, AC and AC+S did not result in any bloat symptoms occurring. The reduction and/or prevention of bloating symptoms could have been a result of the AC, S and/or the CRC rumensin. In the 2002 and 2003 grazing season, CRC boluses were not administered to the steers grazing the AC+S. This was done to determine if the CRC treatment provided more bloat protection benefit than the S. No incidences of bloating were observed in 2002 and 2003 for steers grazing AC and AC+S. Researchers (Berg 2000) have concluded that the sward needs to at least contain about 15 to 20% S for bloat prevention. The observed S percentages of the AC+S sward in 2000, 2002 and 2003 were 13%, 10% and 12%,

respectively. Since the grazing of the AC pasture in 2002 and 2003 did not result in any bloat symptoms being observed it is not clear how much additional benefit S may have contributed to bloat prevention. Although, research studies (Dubbs 1975; Jefferson et al. 1994) have reported that S in mixture with alfalfa do not persist beyond 2 to 3 years. However, this was not observed in our results even though S was generally grazed heavily and the stand has been in production for five years under various extreme environmental conditions (i.e., drought of 2001).

Conclusion

For years 2000, 2002 and 2003, no incidences of bloating were observed for any steers grazing AC or AC+S pastures. Results from this study found that the use of a bloat reducing alfalfa cultivar can reduce the occurrence of bloating and can be an effective method to prevent bloat symptoms from occurring. In this study, the mixing of S with AC may not necessarily provide any additional bloat prevention over just grazing AC. However, S mixed with AC may provide some additional nutritional benefits that improve animal productivity. Further research is needed on S and S plus alfalfa mixtures to clearly determine the benefits of this non-bloating legume on animal grazing performance. The use of AC is just another management tool to assist producers in reducing the incidence of bloating and is not bloat free; therefore, proper grazing management is still needed to properly benefit from AC's improved bloat prevention ability.

Information presented as a result of this research study

Workshops and conferences

Invited presentation for the SWA and DUC workshop at Radville (May 13), Western Canadian Forage and Grazing Conference (December 3-5, 2003), Maple Creek Forage Seminar by SAFRR (December 11, 2003), Southwest Forage Association General Meeting (February 18, 2004) and SAFRR Forage Review in Kindersley (March 2, 2004).

Technology transfer articles and interviews

CKSW interview on the use of bloat reduced AC-Grazeland (February 18, 2003).
CKSW interview on the increasing forage production in southwest Saskatchewan (July 29, 2003)

Tours

Two tours (in July) were organized in which a total of 45 participants viewed and asked questions concerning how to best graze alfalfa. On the research tours various information articles on the preliminary results (reports) of this study were delivered.

Acknowledgments

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Disclaimer

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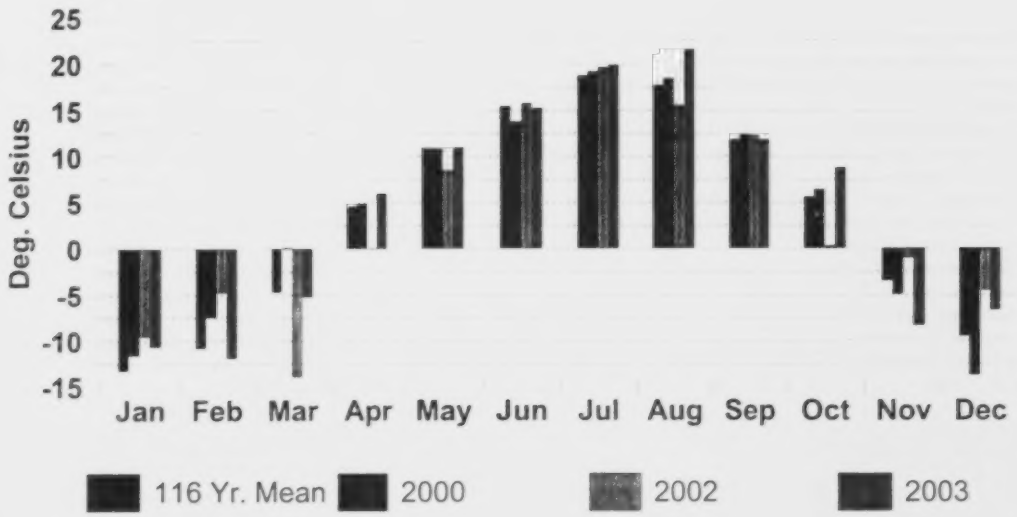
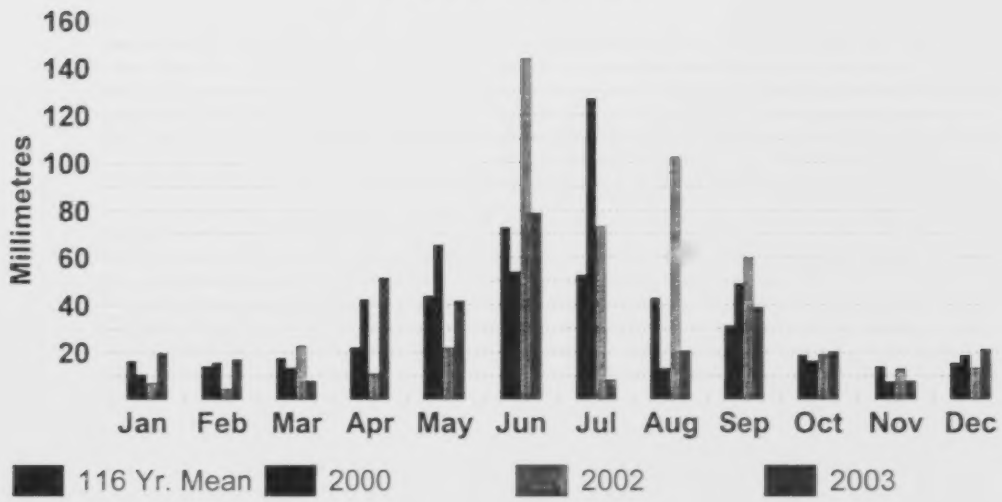
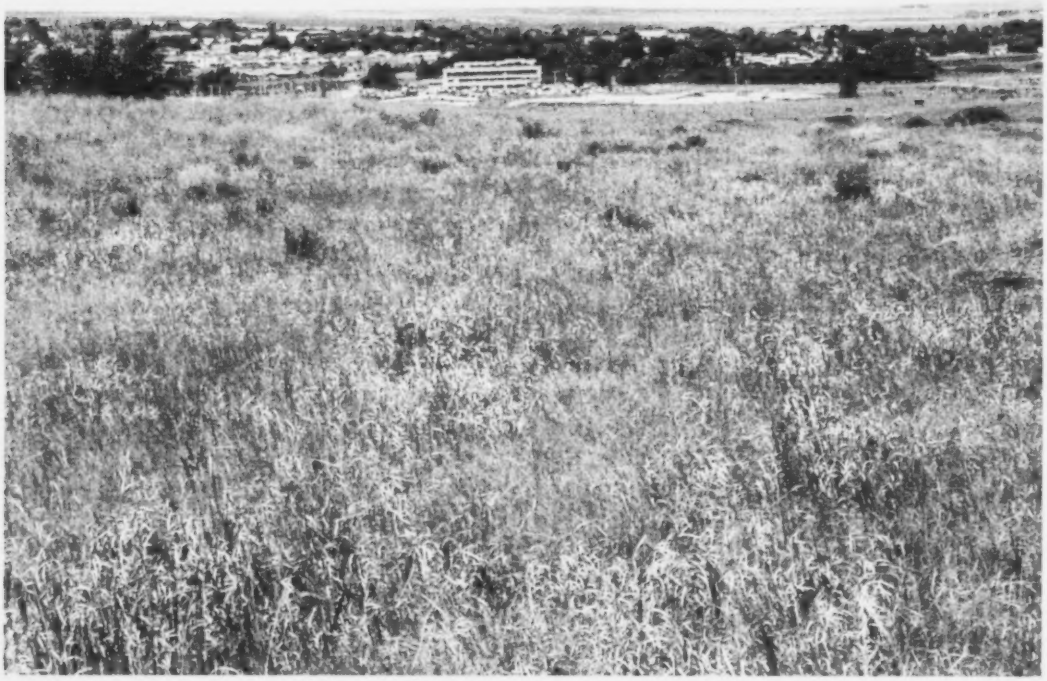
Appendix

MEAN AIR TEMPERATURE

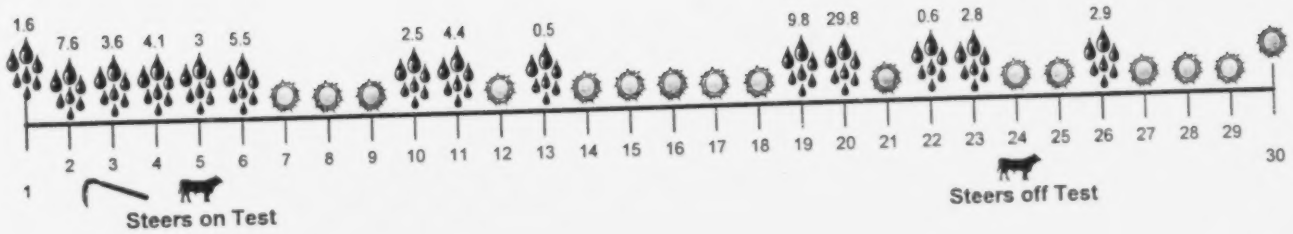


PRECIPITATION





Appendix: 1 Time Line for Precipitation
June 1 to 30, 2003



Precipitation (mm)

Steers on Test

No Precipitation

Sampled Aylds

Total Rain:

78.7 mm
or
3.15 inches